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INTRODUCTION

THIS volume might well be entitled, "THE WORLD UP-TO-DATE," for such is the true scope of its contents. It sets before the reader in a nutshell all important things which have been achieved by various nations for the social, moral, material and intellectual uplifting of mankind.

No field of modern research has been left untouched; no arena of activity has been neglected; no portion of the globe has been overlooked or forgotten when gathering facts for this, the most concise and yet comprehensive work ever offered the public.

For brevity, it is much like the History of America which one of our great historians was recently asked to write. Upon asking the size required, the publishers, with a keen knowledge of the wants and needs of the American people in this busy age, replied, "Give us a history in ten thousand words and we will pay you one hundred thousand dollars."

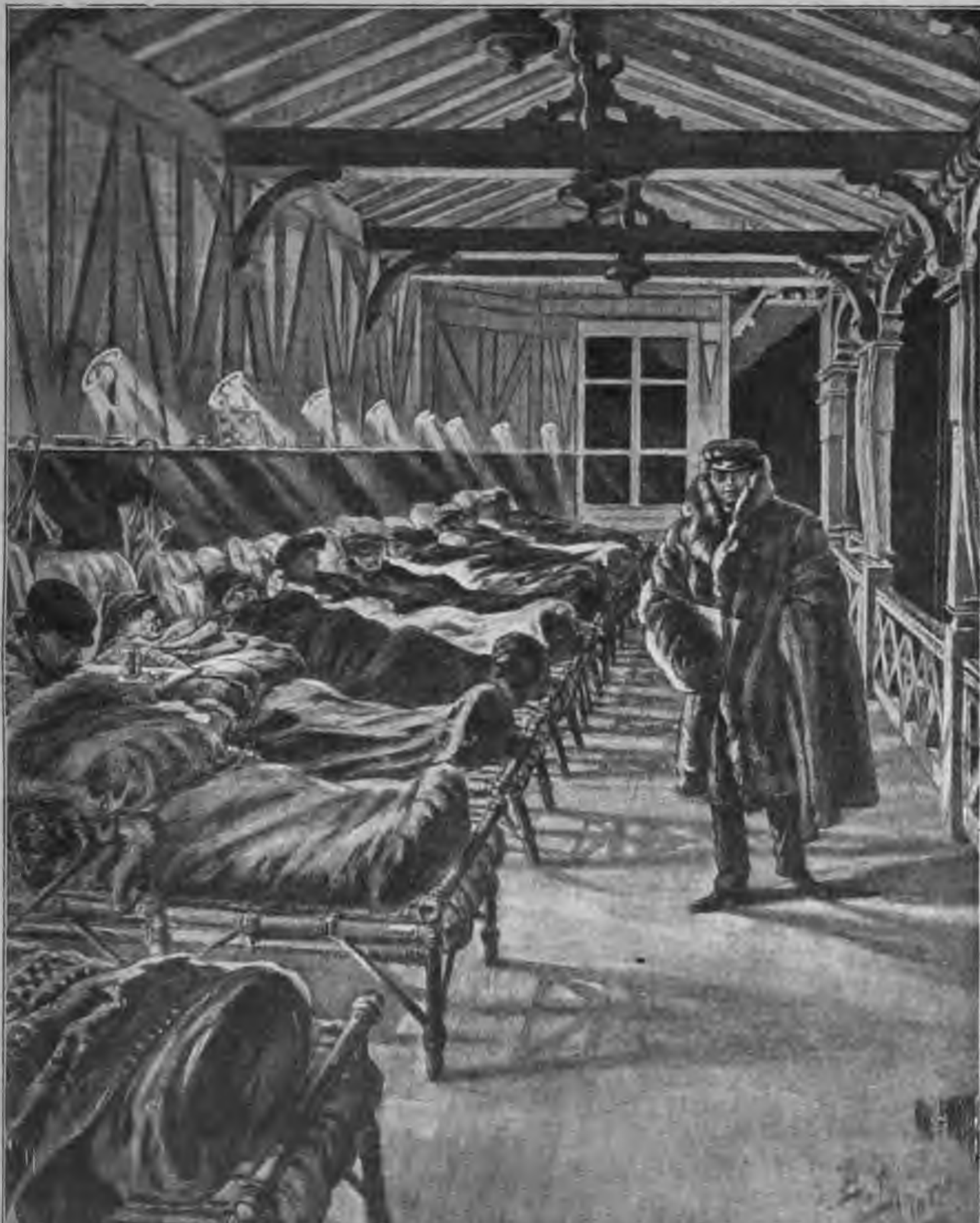
In the shop, on the railroad, in the store, on the farm, in the factory, the counting room, the society meeting, in casual contact on the bustling street, in the seclusion of the fireside and amid the whirl of mighty mechanism, interrogations—subjective or objective—constantly confront the individual, all of which are correctly answered here.

New conditions in every sphere of effort have superseded the old; new problems have arisen requiring new solutions in order to assure success. New ideas, new plans—all must be worked out, and herein are found ways and means to this end. This volume, therefore, comprehending as it does all branches of knowledge, appeals directly to the actual and vital needs of every class of men and women. It can, in fact, be called a complete modern library, available to transform the home, at will, into a veritable school for practical instruction.

The publishers have embellished these pages with photographs secured at an expense of thousands of dollars, and in some cases even at the risk of human life. The interior of the factory, the scientist at work in his laboratory, the different processes of manufacturing, splendid views of nature in her sublimest moods, new methods of mining, and, in fact, every subject susceptible of being photographed are here presented to the eye, with the aid of the camera, and grandly supplement the text matter.

I confidently believe that this volume will prove of practical use in everyday life to all who study its pages.

THE AUTHOR.



THE OPEN AIR CURE FOR CONSUMPTION—LEYSEN, SWITZERLAND.
Night quarters for men. Each person is supplied with a hot water bottle for the feet.

TEN GREAT BOOKS IN ONE VOLUME

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BOOK I

MODERN INVENTIONS AND DISCOVERIES

ACHIEVEMENTS OF THE WORLD'S MOST INGENIOUS MINDS—WONDROUS ADVANCE IN EVERY DEPARTMENT OF UNIVERSAL KNOWLEDGE.

SHIPS OF THE AIR

THE name of M. Alberto Santos-Dumont, the son of a Brazilian coffee planter, will go down in history as that of the man who solved the riddle that for centuries perplexed scientists —that of successfully navigating the skies. In the past ten years more advance has been made in the solution of the problem of aerial navigation than in the whole century since the Montgolfier brothers invented the balloon. With the experiments of Santos-Dumont, in which he showed the dirigibility of his airship, it is believed that the problem has passed the guesswork stage and now needs only further development along lines laid down by him to establish the commercial value of this great invention.

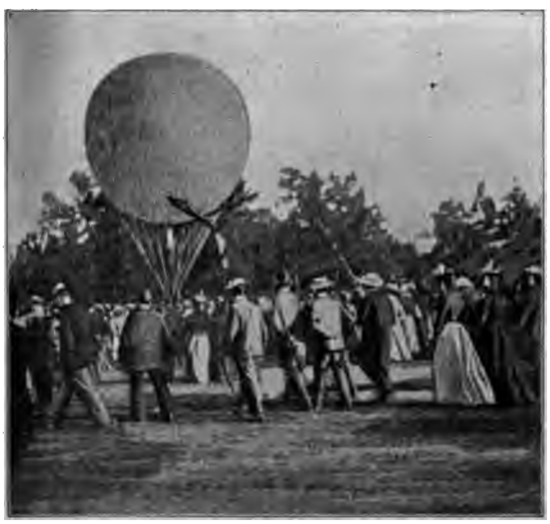
SANTOS-DUMONT,
Inventor of the Airship.

For years students of aeronautics studied kite flying, aeroplanes, balloons with wings and balloons with propellers. Some few inventors were able to make flights of short distances by means of a series of planes which allowed them to soar after the fashion of birds. Prominent among these inventors was Lilienthal, who lost his life in one of his experiments. The true story of the airship up to the present time lies in that of Alberto Santos-Dumont, although somewhat successful flights have been made over London and New York by Leo Stevens in a dirigible balloon. Santos-Dumont was born in Brazil in 1873, and as a very young man became interested in aerial navigation. His first experiments were with spherical balloons, but he soon abandoned these for those of a cylindrical or cigar-shape, and

his triumphant success was gained with the fifth one which he constructed. He won his first large prize for successfully directing a ship about the Eiffel tower, in Paris, from St. Cloud and return. The balloon was 111 feet long by 20 feet in diameter. Paris has always been the center of activity in aerial navigation, and a large club of aeronauts has helped to promote interest in the conquest of the air. One of the members, M. Deutsch, in order to stimulate invention, offered a prize of 100,000 francs ($20,000) for a successful balloon trip over the above-mentioned course in 40 minutes.

SANTOS DUMONT'S WORKSHOP.

The daring navigator rounded the great structure at a distance of not more than 300 feet from it, and at a height of some 500 feet above the ground. Since this achievement the aeronaut has constructed other machines with which he has had only moderate success. One ship lodged on the chimney tops of Paris, while another fell into the sea in the Bay of Monaca. Nevertheless, so great has been his success that his work so far eclipses all that of other experimenters.



SANTOS DUMONT'S FIRST BALLOON (SPHERICAL).

A BALLOON 419 FEET LONG.

Count Von Zeppelin, of Berlin, is also an inventor of some note, and has within the past two years constructed several airships, among which was one of gigantic dimensions. This balloon, which was constructed near Berlin, has a length of 419 feet, while that of Tissandier was only 91 feet in length, that of Dupuy de Lome, 118 feet, that of Haenlein, 132 feet, that of Giffard 144 feet, that of Schwarz, 154 feet, and that of Renard 165 feet. It will be seen that the airship of Count Von Zeppe-

lin is, therefore, nearly two and a half times as large as any previously constructed.

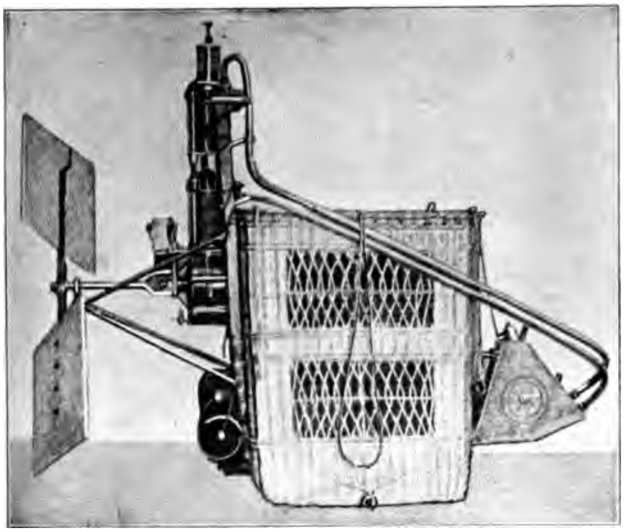
A cylinder, 37 feet in diameter, forms the main body of the balloon, the ends being slightly elongated ogives in shape. The framework of this airship was made of aluminum and consists of 26 polygons of 24 sides each, placed 26 feet from each other, and held in position, perpendicular to the long axis of the balloon, by cross strips of aluminum. Each polygon is strengthened by a network of aluminum wire, which extends from a small central circle, in all directions, to the inner side of the polygon, just as spokes of a bicycle wheel extend from the hub to the rim.

Seven separate compartments are thus formed, and inside of each of these compartments, as well as over the outside of the entire framework, is a net of strong but light-weight hemp cord. Into each of these compartments, inside the nets of aluminum wire and hempen cord, is placed a balloon, which is in no wise connected with any one of its fellows. Each of these seventeen balloons is filled separately, and if by any accident any of them burst or leak, the carrying power and utility of the balloon as a whole are not endangered or sacrificed.

Under the balloon and attached firmly to it by strong aluminum bars are two gondolas, also of aluminum. These gondolas are each 21 feet long, five feet wide, and three feet deep, and have under each of them large spiral springs, which prevent jarring the entire machine when landing after an ascension. The gondolas are connected by a bridge one foot wide, which is also firmly bound to the balloon by means of aluminum bars and ropes.

By courtesy of the "Scientific American."
"SANTOS DUMONT'S NO. 1."

In each gondola is a motor of 15 horsepower. Benzine is used as fuel, as, despite its great inflammability and the danger from fire which its use engenders, it is found to be the most practicable. Connected with the motors are four large aluminum screws, similar to those of steamships, which serve to propel the bal-



By courtesy of the "Scientific American."
BASKET OF "SANTOS DUMONT, NO. 1."
Showing Propeller and Motor.

loon through the air. Two of these are placed at the forward end, at a point where the straight sides of the cylinder begin to converge toward the ogival and bow of the airship, and the other two are at a corresponding point at the rear.

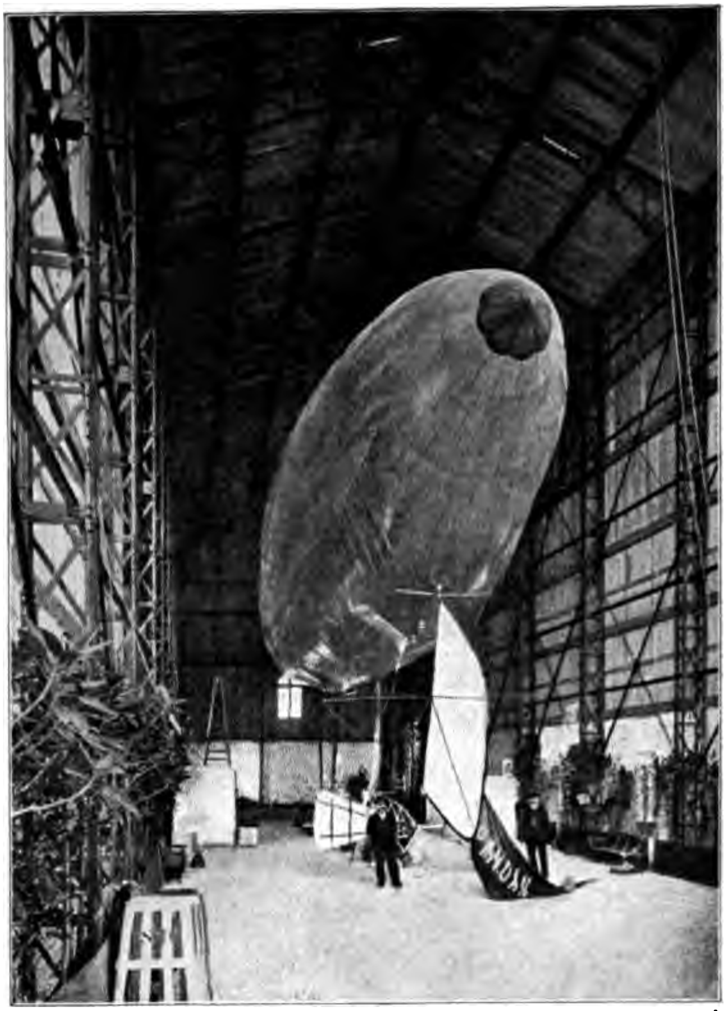
The balloon, or airship, is steered by a sort of rudder consisting of a framework covered with balloon cloth, and which can be moved to the right or left, or up and down. One of these is at either end of the balloon, and changes its course in the same way and on the same principle as does the rudder of a ship. A weight which slides along a rope is attached to the underside of the gondolas and the bridge which connects them. If this weight be placed under the rear gondola the rear half of the balloon, being heavier than the fore, remains lower in the air, and the propelling screws being set in motion, the balloon moves forward, and, of course, rises. If the weight be moved forward the angle is changed until, when the weight reaches the center, the balloon moves in a straight line, and then, as the weight advances more and more the front becomes heavier than the back and the balloon descends. A rope reaching from the bow to the stern of the balloon, and hanging slack under it, combines with the weight in accomplishing the directing of the airship.

The ship of Santos-Dumont, while not quite as long as that of Count Von Zeppelin, is constructed with as much care and of nearly the same material.

SANTOS DUMONT'S NO. 9.

THE LANGLEY FLYING MACHINE.

A balloon styled the "Langley flying machine" was constructed in the summer of 1903 under the supervision of experts in the employ of the United States government, who pronounced the basic theory on which it was planned infallible. The cost of designing and making it, together with the expense attending several experimental trips under disastrous conditions, was $72,000. The final test, September 12, 1903, resulted in a complete collapse of the airship, on account of a lack of rigidity in its frame, and by reason of weakness in its propelling apparatus, in which strength had been sacrificed for the sake of lightness.



By courtesy of the "Scientific American."

THE INTERIOR OF THE AERODOME.

Showing Its Construction, the Inflated Balloon, and the Pennant with Mystic Letters.

THIRD SERIOUS DISASTER.

The final wrecking was the third and most serious disaster which befell the inventor. Three propellers had been previously broken during experiments, and other parts were disabled while the secret tests in the Smithsonian Institute were being conducted.

GATHMANN'S DESIGN.

Louis Gathmann, who invented the gun bearing his name, is planning a flying machine weighing 15,000 pounds, constructed of nickel steel, with two 500-horse-power engines. The lifting power of this machine is centered in a heavy, revolving horizontal fan, the blades being shaped like a Maltese cross. The cost is estimated at $136,000.

AUTOMOBILES AND THEIR DEVELOPMENT

The age has arrived when the horse as a means of power for general traction is well on the wane. While it is not intended by this statement to convey the idea that the time will come when horses will no longer be used to draw vehicles, nevertheless the development in the past decade of the automobile, or automatic vehicle, has attained such success that it is no longer a mere experiment. Today, upon the streets of any of our cities may be seen horseless carriages, trucks, wagons and fire engines, while in the country the traction engine and the automatic plow are gradually coming into use.

Industrial science affords no more complex problem than the construction of a carriage which contains within itself all the elements of swift and safe transit for persons and goods. The development of the automobile has been slow until a comparatively recent date. Briefly, and to avoid ancient history, let us take up the story of the horseless vehicle in its nearly perfect form.

The principal motive powers for the motor vehicle to-day are electricity, gasoline and steam, although there are several chemical and other agents, such as compressed air, which are in occasional use. In general, however, it may be stated that the last named have been dropped.

The relative merits of the three systems now generally in use may be summarized as follows:

THE ELECTRIC MOTOR.

The greatest difficulty that is presented in the problem of driving a carriage by electricity is that of the storage battery. For many years a great number of scientists have busied themselves striving after improvements in the method of storing electricity. The result of these experiments has shown that weight is a serious handicap. Nevertheless, so convenient is the electrical method that the electric motor probably is

A FASHIONABLE AUTOMOBILE.

the most successful, in its particular sphere, now in use on automobiles.

The mechanical arrangement of the average electric automobile consists of a battery, or series of batteries, in which is stored sufficient electrical fluid to serve for a several hours' run. These storage batteries must be filled at some power station when run down, an operation that takes some time. It is customary in the large

cities, on automatic "bus" lines, to have a wire connection at the regular station of the "bus," whereby the batteries may be kept constantly supplied. From the storage batteries run connecting wires to a motor usually located on the rear axle of the vehicle, or in the hubs of the rear wheels.

By the ordinary method of levers, the power is imparted to the motor, or thrown off at will. Very effective brakes, of necessity, make up a part of the complete automobile. The best equipped machines can come to a full stop from a high rate of speed in a very few feet. The steering gear is usually attached to the front wheels, and is operated by a horizontal lever near the front seat. However, some cabs steer by the rear wheels. The most up-to-date machines are equipped with electric lights and bells.

THE GASOLINE MOTOR.

The motive power of the gasoline automobile is derived through the constant explosion of gasoline and air combined in proper quantities, which in turn operates a piston and a fly wheel, and finally the wheels of the carriage. The greatest advance in this style of pleasure automobiles has been made in France, and from that country some of the best machines in present use in this country have been imported. The mechanical arrangement of the gasoline motor embraces a tank for gasoline, a device for admitting air to the gasoline, a mixer or carburettor, an electric "sparker" which ignites the mixture under pressure, by means of which the explosion which drives the piston is produced. The usual method consists of four cycles. The spark first ignites the gasoline, and this explodes, driving forth the piston, which, in turn, recedes, driving out the spent gases, thus preparing the cylinder for exploding the next intake of gasoline and air. A corresponding operation is in process in the other cylinder, both being connected with same crank shaft. A water jacket is one of the essentials of this machine, to prevent too high a temperature resulting from the constant explosions. Tremendous speed has been attained with this style of machine, a record of over eighty miles per hour having been made.

By courtesy of the International Harvester Company of America.
AUTOMOBILE MOWING MACHINE.
At Work in a Field.

Some of the difficulties attached to this method are the seeming impossibility of

readily regulating the speed from high to low gear; the constant jar and racket due to the exploding gasoline; the disagreeable odor that follows the machine; the serious difficulties arising from the delicate adjustment of the sparking apparatus, and accidents occurring from starting the fly wheel by hand. All of these defects, however, have been obviated in the latest improvements. Some of these machines cost as high as $10,000.

THE STEAM MOTOR.

The steam machine is operated by a simple steam engine, the steam for which is generated by heat from oil or gasoline. Among the chief points in favor of this method are its comparative freedom from vibration or jar, its comparatively noiseless operation, and the universal knowledge of its propelling power.

This vehicle is equipped with a burner, a boiler, cylinders and a chain connecting

By courtesy of the Chicago Motor Vehicle Co.

BACKING THE WHEEL OFF A TWELVE-INCH BLOCK ONTO AN EGG, CRACKING THE SHELL WITHOUT SPILLING THE CONTENTS, AND THEN MOUNTING THE BLOCK.
A Demonstration of Perfect Control.

the fly wheel with one of the axles of the wagon. As in the gasoline method, fuel for trips of over a hundred miles can be carried easily.

Self-propelling vehicles are built in scores of patterns. Some of the heavier drays use compressed air for motive power. In Paris the fire department is equipped with an electric automobile, and in other cities the chiefs use light vehicles in running to fires. The Chicago Motor Vehicle Company is operating a very successful gasoline street car. Ambulances, ammunition wagons, bicycles and light railway hand cars are driven by light gasoline engines. Many feats of cross-country riding, mountain-climbing and the like have tested the astonishing capabilities of the automobile.

Motive power for farm purposes is receiving more and more attention. The latest departure is an automobile mower which is just being put on the market by the Deering Harvester Company of Chicago, or, to be more accurate, the International Harvester Company, of which the Deering is now a part. Their experiments began in 1894 and they succeeded in getting one of the machines ready for exhibition at the Paris Exposition, where it attracted much attention. In competition it worked perfectly, running at any speed and turning even more easily than a team of horses.

The mower is equipped with ball and roller bearings and is propelled by a motor which consists of two six-horse power gasoline engines mounted tandem on a large pipe six inches in diameter and five feet long. The rear end of this pipe is secured to the mower frame in the place of the ordinary draft tongue and the front end is supported by a steering wheel. The machine is guided by the wheel which the operator holds in his left hand. The levers at his right are for operating the cutting bar.

By courtesy of the Chicago Motor Vehicle Co.
CLIMBING A 25-PER-CENT GRADE LOADED.

Although this motor is designed for the mowing machine it can be used for other purposes. By taking off the cutting apparatus it can be made to draw loads, grind feed, pump water and do many other useful things.

MESSAGES WITHOUT WIRES

GUGLIELMO MARCONI.
The Genius Who Developed Wireless Telegraphy.

Possibly the most conspicuous of all the recent discoveries in science, and farthest reaching in its ultimate effect upon our material affairs, is that of the successful system of wireless telegraphy developed and established by the genius of the young inventor, Guglielmo Marconi. His first experiments resulted in communication at will without wires, over a distance of over 250 miles. The public had hardly become accustomed to this fact when the announcement was made upon the authority of the young inventor himself, verified by unmistakable evidence, that on December 12, 1901, he had received signals across the Atlantic by the same system. The far reaching results of a system by which messages are transmitted without the preliminary stringing of wires or cables, by which ships may be spoken to in mid-ocean, far from sight, by which distress signals can be sounded from sea to shore, and by means of which continents can be connected without the aid of cables, is almost too stupendous for realization.

A. B. SALIGER, WITH RECEIVING APPARATUS.

Let us consider the methods by which the sender of the wireless message operates. Those of us who are unfamiliar with electrical apparatus are accustomed to consider only such electrical streams as take their way along wires. But there are a great many other electrical streams unconfined by wires, which can be quite as telegraphic as if they were kept on paths of copper and steel.

Discoveries of this nature were made as long ago as 1842, and others looking in the same direction followed. Marconi makes no claim to being the first to experiment along the lines which led to wireless telegraphy, or the first to signal for distances, without wires. But in spite of his prompt acknowledgment to other workers in his field, it has remained for Marconi to perfect a commercial

system, and put it into practical working order over great distances.

THE COHERER.

The first two essentials in wireless telegraphy are the vertical wire and the "coherer," which by its exquisite sensitiveness makes it possible to register messages as received. Before the development of the receiving apparatus of Marconi, electricians learned how to develop electrical waves. These waves have long been utilized for sending messages through wires. Marconi started with the assumption that inasmuch as electrical waves may pass through the ether, which fills all space, as readily as through wires, if these waves could be controlled they would convey messages as easily as the wires. Then he undertook to make an instrument that would produce a peculiar kind of wave, and another apparatus which would receive and register this wave at a distance from the first.

GENERATING THE HERTZIAN WAVE.

This wave is called the Hertzian. It is generated by a battery, and passing in brilliant sparks between two brass balls, is radiated to space from a wire suspended on a tall pole. By the shutting off and turning of this peculiar current, the waves are so divided as to represent the dots and dashes of the ordinary Morse alphabet of telegraphy. The waves which come from the transmitter are received on a suspended wire elevated either by a mast, kite or balloon. This wire is exactly similar to the one used in the transmitter, but by the time the waves have passed over a long distance,

INTERIOR OF EXPERIMENTAL STATION AT THE FOOT OF OAK STREET.

they are so weak that they could not of themselves operate an ordinary telegraph instrument. For the necessity thus arising, Marconi found a remedy in his coherer. This instrument is a little tube of glass, about two inches long, and as large as a small lead pencil, in diameter. The ends are plugged with silver and nearly meet within the tube. In the space between the plugs there is a small quantity of nickel and silver filings, finely powdered. The filings

MARCONI STATION.
The Great Wireless Telegraphy Station at Glace Bay, Canada. Towers each 215 feet high, from which Mr. Marconi flashed the first wireless sentences.

are jumbled together like the particles of a sand heap, and in that state they form a very poor conductor. When they receive an electrical wave, however, they cling together as tightly as a solid conducting bridge that carries a current from a local battery to a receiving telegraphic sounder of common pattern. If it is connected at one end with the suspended wire and at the other end with the Morse instrument, there is a dot or dash printed, according to the signal that has been sent by the transmitter, miles away. Then a little tapper, actuated by the same current, strikes against the coherer, and the particles of metal are jarred apart, or de-cohered, becoming instantly a poor conductor, and thus stopping the strong current from the home battery. Then another wave comes through space, down the suspended wire, into the coherer, drawing the particles together again, with the result that another dot or dash is printed. After these processes have continued for some time, a complete message may be picked out upon the tape.

In his early experiments Marconi believed that in order to cover great distances, very high masts must be used; the greater the distance, the taller the mast. He thought the waves were hindered by the curvature of the earth, but his experiments have proven that very tall masts are not necessary.

Now that the sensational and "nine days' wonder" period following the invention of the wireless telegraph has passed, and the period of practical development and extension has set in, we shall probably hear much less through the public prints about this really marvelous device, although, before we are fairly

TEMPORARY EXPERIMENTAL STATION.
Showing Pole and Air Wires.

aware of it, it will be in general and familiar use throughout the world. That wireless telegaphy has already been brought well within the realm of practical usefulness is evidenced by the fact that the United States government is establishing a system for its own use in Alaska, and that nearly all the ocean steamship companies are equipping their vessels with wireless apparatus. That it is being taken up also as a new and promising field for the investment of capital is evident from reports from the financial world, which state that already scores of companies have been organized for the purpose of operating an extensive system of both wireless telegraph and telephones throughout the United States, Canada and the old world.

THE ROENTGEN X-RAY

Science has recently discovered a "new thing under the sun" in the X-ray, or Roentgen ray, or cathode light, as it is sometimes called. This is a weird property of electricity, which enables one to see partly through solid objects, and has been of great service to science in locating dislocations, breaks in bones and bullets in human bodies, besides being put to other uses since its great power was discovered.

As long ago as 1857, Dr. Heinrich Geissler, a celebrated German scientist, who learned the trade of glassblower, made some glass tubes from which the air had been exhausted. The tubes were made of thin glass and in each end platinum wires passed through to the inside of the tube. These tubes are still known as Geissler's tubes, and for years have been used to illustrate the phenomenon which accompanies the discharge through them of highly rarefied gases and vapors.

THE GEISSLER TUBES.

These tubes vary in size from a small quarter-inch cylinder, three or four inches long, to tubes two inches in diameter and ten inches long. They are made in several shapes, to meet the needs or whims of the user. The platinum wires which lead into the tube are usually tipped with small spears or disks of platinum or aluminum. These tubes contain air in various degrees of rarefaction; that is, the air in some tubes is more completely exhausted than in others, and thus the tubes approach more nearly a perfect vacuum. When the terminals—the wires leading from the positive and negative poles—of the secondary coil of an ordinary induction coil are connected with these "electrodes"—the platinum wires in the ends of the tube— and an electric current is sent over the wires, various colored light effects take place inside of the tube. These depend upon the degree of air rarefaction, and also of the kind of gas that is put into the tubes; for, sometimes, after the air has been exhausted, the tube is filled with hydrogen, nitrogen, carbonic acid gas and other gases.

THE INDUCTION COIL.

The induction coil is an apparatus which has two coils of wires. The inside coil is made of thick, heavy wire, and the other coil, which entirely surrounds the inside coil, is made of thin wire. The inside coil is called the "primary" coil and has but

few turns of the heavy wire. The outside coil is called the "secondary" coil, and is made with many hundred turns of very fine wire. The two coils are not connected with each other in any way, but if a current is made to flow through the "primary" coil, it "induces" a current in the "secondary" coil. The battery connected with the primary coil may produce a large current with little force. It will induce in the secondary coil a small current of very great force, or, as we say, "the electro-motive force of the induced current will be higher than that of the primary current." When this induced current is sent through a Geissler's tube, the tube is filled with different colored lights. If the degree of rarefaction is not very high, lustrous layers of light, separated by dark bands, are produced throughout the tube. If the tube is filled with rarefied air the color of the bands will be a rosy red; if filled with nitrogen gas, an orange-yellow light will be produced. Hydrogen gas will make a pale bluish color, and carbonic acid gas will give a light that is a pale green.

By courtesy of W. Scheidel & Co., Chicago.

BONES OF THE FOOT AS SEEN THROUGH A SHOE BY MEANS OF THE X-RAY.

The bands of light that are seen in the tube are curved, and the concave surfaces are nearest the positive electrode. These bands extend nearly the whole length of the tube, but between them and the negative electrode is a dark space, while immediately surrounding the negative electrode is a beautiful pale-blue glow. As the rarefaction in the tube is carried further and further, the light from the positive end of the tube tends more and more to fill the tube, although in general

receding from the negative end. At the same time the beautiful lavender glow from the negative end spreads more and more, filling more of the space around the negative electrode. If the rarefaction is carried still higher, the positive light which now occupies a considerable part of the tube and takes more or less the shape of the enclosing vessel, divides up into any number of cup-shaped layers at right angles to a line drawn through the center of the tube, the long way. These layers are separated from each other by darker intervals, and their concave sides are turned toward the positive electrode. Although the positive light changes with the increased rarefaction of the air, the negative light remains substantially constant. The lavender light around the negative electrode is still the same, being uniform, but is more intense and spreads over more space. These rays from the negative pole shoot across the tube in straight lines, and striking upon the glass walls of the opposite side, produce a most brilliant fluorescence. If a screen of mica be put in the path of these negative rays, it stops them, and the shadow of the screen is outlined on the glass walls of the tube, surrounded by a bright fluorescence. The negative is called the "anode," and the negative electrode the "cathode." Thus the name of cathode ray is given to the negative light in the Geissler tube.

THE CROOKES TUBE.

The Crookes tube, in outward appearance, is not different from a Geissler, but the air in the former is always exhausted to a much higher degree than in the latter. The exhaustion has been carried as high as 1-20,000,000 of an atmosphere. When it is remembered that one atmosphere will sustain a column of mercury thirty inches in height, and exerts a pressure of about fifteen pounds to the square inch, one can but vaguely imagine the exceedingly small

By courtesy of W. Scheidel & Co., Chicago.
THE BONES OF THE FOOT, AS SHOWN BY THE X-RAY.

quantity of air that is left in a tube so exhausted.

When a magnet is brought near a Crookes tube, the positive light is rotated by the magnetic influence, but the cathode rays act differently. If the negative (cathode) end

of the tube is placed over the space between the poles of a horse-shoe magnet, the lavender glow around the negative electrode, seemingly, will be drawn to one side, and an arch reaching from pole to pole in the tube will be made; with the concave face toward the two poles of the magnet. Now, the X-rays come from the cathode end of the tube, but they are not what we call cathode rays, for, it has been proved that a magnet has no influence on the X-rays, which pass straight through the magnetic field, even though the cathode rays are deflected by the magnet. The X-rays will pass through a book or a board and brighten a phosphorescent screen, or they will go through leather, flesh, wood, paper, cloth, and other things that cannot be penetrated by ordinary light, and act upon a sensitive photographic plate. Sometimes the Crookes tube is of bulbed or globular shape, and sometimes it is shaped like a Geissler tube. When it is used to make an X-ray "shadowgraph," the electric current is automatically broken many times a second, and this increases the intensity of the light.

THE SHADOWGRAPH.

Since the discovery of the power of the X-rays scientists have developed it greatly. Now, it is possible to watch a man's heart beat through his body and clothing, or to take photographs of interior organs of the body or substances lodged in them. Of course, these photographs are only dimly outlined as their name, "shadowgraph," would indicate. Yet they have been of great value in saving life and in directing surgical operations. When a shadowgraph is to be taken, the subject is stretched over a photographic plate holder containing a sensitive plate. Then the X-ray machine is set to working, the rays pass through the body upon the plate within the holder and expose it after the fashion of picture taking. The rest of the process is just like that in finishing photographs.

ADVANCES IN APPARATUS FOR THE PRODUCTION OF THE X-RAY.

When the X-rays were discovered by Prof. Roentgen, of Würtzburg, there were very few pieces of apparatus suitable for the production of the rays. Since that time, manufacturers of both coils and static machines have increased in number until now there are fully twenty reliable firms in this country alone. In Chicago, four or five good static machines are manufactured, and a larger number of good induction coils.

Among the static machines those of C. F. Birtman & Co., and N. O. Nelson & Co., are not only beautiful to look upon but are efficient as energizers of the X-ray tubes. These machines are of the same general type. The X-ray furnished by these machines is excellent for fluoroscopic examination. The patient is placed near the X-ray tube so that the rays will pass through the body. The fluoroscopic screen will be lighted up by the X-rays that pass through the body of the patient. The thicker parts obstruct the ray more than the less dense parts, and thus a shadow is cast upon the fluoroscopic screen. This screen is ordinarily closed in a hood which has a sort of oval aperture. The margin of this aperture is covered with lamb's fleece, and will accommodate that part of the face surrounding the eyes. When the rays are not in action, the operator will be looking into a perfectly black box, but as soon as the rays are generated, the screen is lighted up in the manner described above.

Of the good induction coils in this city we shall mention those of Scheidel & Co., and the Western X-ray. These coils when attached to a 110 volt circuit will give a continuous spark of deafening sound over a gap of twelve inches or more, depending upon the size of the coil. The circuit from the street is sent through a suitable resistance, so that the current will not be too strong. It then proceeds through an interrupter into the primary portion of the induction coil. This primary is composed of rather large wire, of a variable number of turns, depending upon the size of the induction coil. In the center of this primary are a great number of straight iron wires, all cemented together into a cylinder. The secondary coil is composed of a great number of turns of very fine wire, the full length of the wire being many thousands of feet. All these turns have to be very carefully insulated from each other so that the spark cannot leap from one wire to the other, thus short-circuiting the machine. None of the currents from the street gets into the secondary wire, because the latter is entirely insulated from the primary, but when the current in the primary is broken a current of very high voltage is generated in the secondary coil. It is this high voltage current which is carried by connective wires through the Crookes tube and energizes this and thus produces the X-ray.

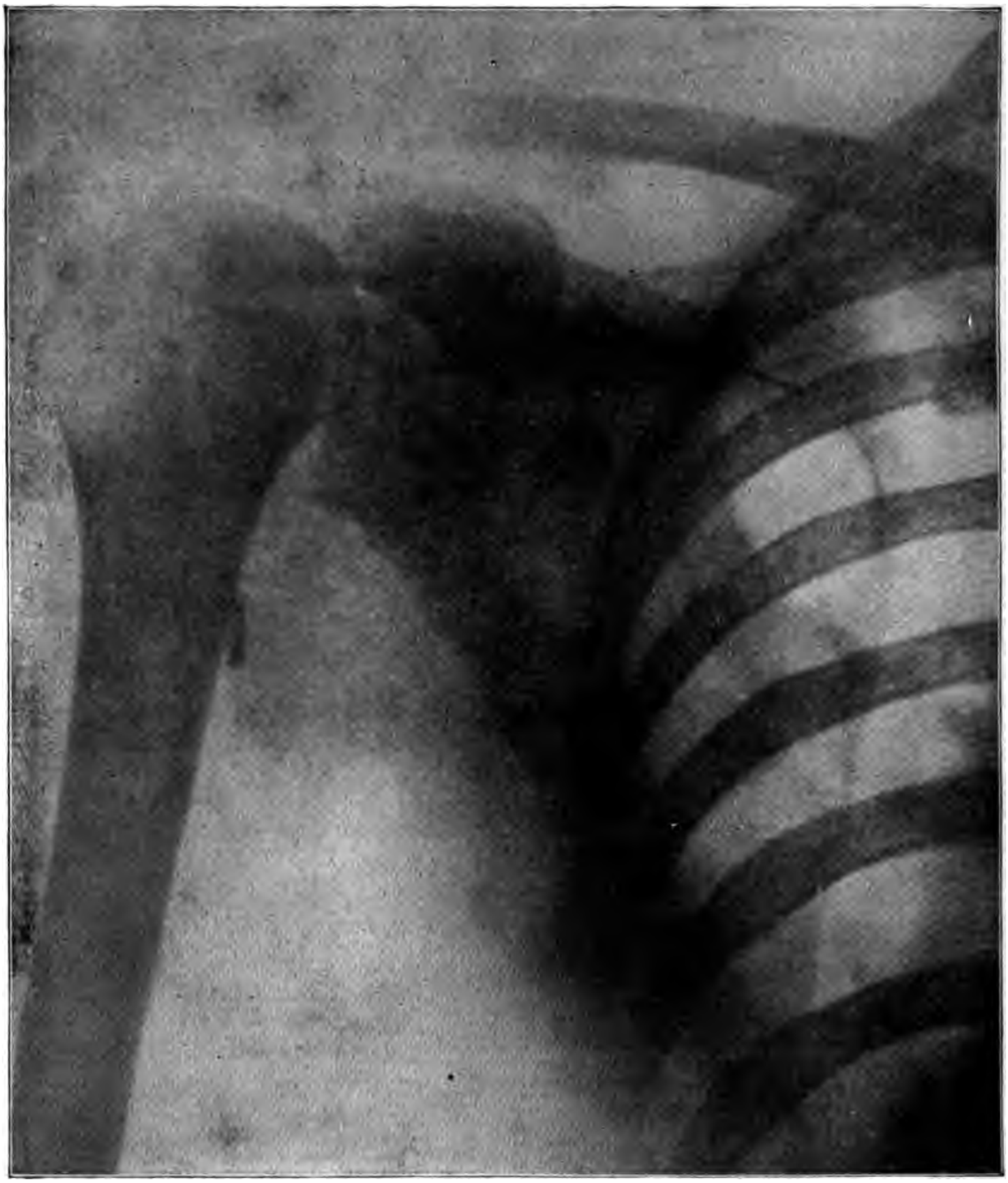
A great improvement of coils was achieved when the rotary mercury-spray interrupter was invented. The voltage current passes through this instrument along a spray of mercury, and is thus very rapidly interrupted.

Another style of interrupter, called the electrolytic, is one of the most successful of the devices invented in this connection. The interrupter consists of a glass jar about half full of diluted sulphuric acid. The positive pole of the street current is connected with a German silver wire, which drips down into the

By courtesy of W. Scheidel & Co., Chicago.

THE BONES OF A HAND AS SEEN BY THE X-RAY.

liquid within the glass tube, as seen in the cut. The wire rests upon a small porcelain



By Courtesy of W. Scheidel & Co., Chicago.
BULLET, AS DETECTED BY THE X-RAY.

cup in the negative end of the cell. The negative pole is a rod of lead shaped like the letter "L." The current on passing through the sulphuric acid, is interrupted by the formation of small bubbles of gas, and this interruption, which is very rapid,

produces a very high voltage current in the secondary portion of the induction coil. This is the only interrupter which can be used on an alternating current, and is therefore of great service where only this current is available.

Another great improvement was required in Crookes tubes before the medical profession could use the X-ray to advantage. The early tubes would stand very little current, because the terminals were not strong enough to withstand the immense heat effects of the cathode ray.

As shown in a diagram of the inventor the cathode terminal is concave (hollowed), while the positive is a double terminal shaped like dick. The one near the center of the tube receives the bombardment of the cathode rays. These rays are sent out from the negative whenever the tube is in action, and because the cathode is concave, they are brought to focus at one point, at which point is placed the anode. The theory is now pretty well established that the X-rays are produced by the sudden stopping of the cathode rays at the anode. The X-rays are therefore produced at this point of bombardment, and they spread out, passing through the walls of the tube into the room. They are themselves entirely invisible, but they have the property of making a few chemicals give out light in a very remarkable manner. The most approved chemical is the double salt, platino-cyanide of barium, which is spread upon a cloth in a pulverized condition.

It was early discovered that the X-rays could penetrate light proof paper and fog a photographic plate. If the hand is placed so that the X-rays can pass through it before reaching the plate, the bones will obstruct the rays more than the plate, and that part of the plate beneath the bones will be less affected than the part next to the tissue. Thus by proper development of the plate an image of the bones of the hand will be seen. The same holds good for all other parts of the body. The usual method is to place the patient on a suitable table in a reclining position. The tube is so arranged that the rays will pass downward through the body of the patient. A photographic plate is then placed beneath that part which is to be photographed. With the earlier apparatus, a long exposure was required to take even a hand, but now very short exposures of the thickest parts of the body will be sufficient. The X-rays are used by the surgeon in detecting any fracture of the bones, dislocation of the joints, or the presence of a foreign body. Formerly, it was a difficult operation to probe for a bullet, but now the projectile can be exactly located with the X-ray. Swallowed coins and pins, often a source of the greatest anxiety to parents, need not be so much feared. A metal object is readily located in any part of the child's alimentary canal, and its progress can be kept track of as it moves through the system. Many deformities seen in the arm and wrist due to incorrect reduction of a fracture are now without excuse, because the X-ray will show wherever a bone is misplaced.

But, of even greater interest is the use of the X-ray in the treatment of certain diseases. The X-ray cannot be expected to cure all diseases, and it certainly should never be tried excepting by those who have had experience in its use, but the number of diseases in which benefit has been derived from its use is constantly increasing. In no disease has it been more successful than in the treatment of Lupus. This is a

disease often affecting the face, producing a hideous raw surface on the cheek, and looking something like an ulcer, but only affecting the outer skin. Hundreds of such cases involving other parts of the body, as well as the face, have already been reported cured. Another disease which is justly dreaded is cancer. This is not a simple disease, but has many varieties, some of which have yielded remarkably to the X-ray treatment, while in others the treatment has produced little effect. "Smokers' Cancer" has yielded very well to the X-ray, and it is an interesting question whether the X-ray might not have prolonged the life of General Grant, had it been discovered and applied early in the progress of the disease. It has been applied to tumors in different parts of the body, and to swollen glands, but the treatment should always be under the direction of a competent surgeon, because in too many cases only an early operation will eradicate the dreaded growths. Rheumatism and cases of facial neuralgia have been benefitted by the rays.

The most powerful X-ray tubes have been recently patented by R. Friedlander & Co., of Chicago. These tubes have the most powerful anodes, so that very strong currents can be sent through them without destroying them. The quantity of the X-rays produced therefore is remarkably increased. Another point of importance is the vacuum of the tube. The earliest tubes were non-adjustable in vacuum, and therefore only one kind of X-ray could be generated. In these improved tubes, however, the vacuum can be perfectly regulated, and as the kind of the X-ray depends upon this vacuum, the operator has at his disposal a great variety of rays.

In the early stages of this new science, newspapers contained accounts of severe X-ray burns, and some of these accounts were not very much exaggerated, but as X-ray photographs are now taken with shorter exposures, this danger is overcome.

A new danger, however, has appeared which affects more particularly the operator than the patient. It has been found that continued exposures to the X-ray will produce a thickening and crusting of the skin which becomes at last very alarming. The finger nails are sloughed off, and large cracks in the skin will develop. When the patient is being treated continuously for a cancer or some other disease, the surrounding tissue must be protected from the X-ray. It is then necessary to use a screen, which will protect both the operator and the patient. A very successful shield just placed on the market is an invention which has suitable openings to allow any amount of the rays desired to come out of the tube, according to the different sizes of the openings. The rays can be projected into the mouth in treating a cancer of the tongue, or the back part of the mouth, while the patient's face is successfully shielded. A great number of other skin diseases have been successfully treated; even superfluous hair has been removed and pustules have yielded to the treatment.

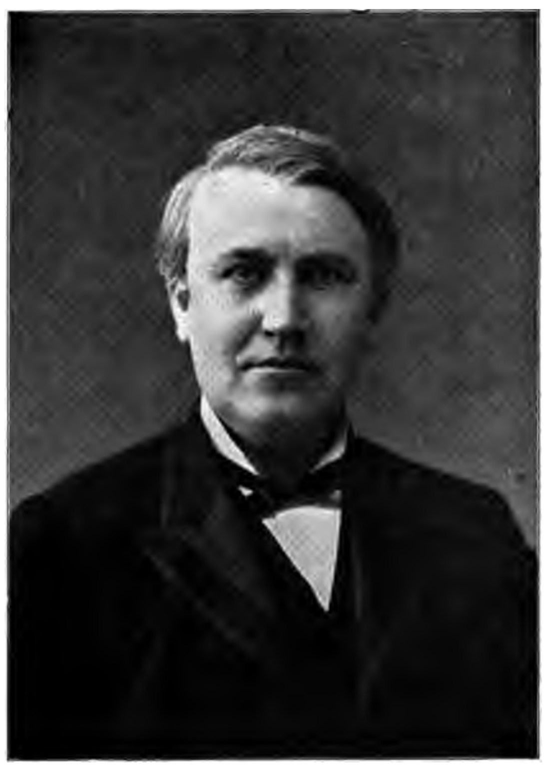
It is thus apparent how a purely scientific discovery has led to important advancements in several different lines of industry, and has been utilized in medicine in the treatment of numerous diseases which had been pronounced incurable.

NEW WONDERS OF THE ELECTRICAL WORLD

BELL'S FIRST TELEPHONE.

Something over a century ago, Benjamin Franklin drew from the clouds by means of his kite and door key, a spark from a cloud laden with electricity. Lightning, it was called then, and, in fact, that is what it was in miniature form, for lightning is simply one of the great phenomena of electricity. From the time of Franklin, to the present, the day of Edison, the Wizard, Gray, Bell, Tesla, Morse and Marconi, the development of this weird power has been marvelous. To-day one can ride in cars driven 130 miles an hour by electricity, or girdle the globe with a telegraph message, or talk across the Atlantic ocean on an electrical wave without the aid of wires, to say nothing of being supplied with light, heat and all kinds of motive power from this unknown quantity. For, practically, unknown it is. Experts are only beginning to learn a little about it, and yet that little has produced wonders.

If you rub rubber, resin, glass, vulcanite, amber, sealing wax or a number of other substances, it will be found that they will attract bits of paper. If you rub a cat's fur the wrong way briskly on a cold night, you will see sparks fly. If you shuffle your feet briskly along a Brussels carpet, and touch your finger to another person's skin or to a piece of metal, a spark will leap from you. These are the simplest methods of developing electricity. The power of this



THOMAS A. EDISON.

All the world knows his career as newsboy, telegrapher, inventor of electrical machinery and organizer of great business enterprises to utilize his discoveries and inventions. He is constantly working out new ideas in his laboratory at Orange, N. J.

invisible force when properly developed is immeasurable. It can be produced by chemicals, and the belief is growing that it is elemental with all nature. This power, when created and stored away, is the agent by which the marvels of electrical genius are worked out.

The most common of the uses to which electricity is put, aside from that of carrying telephone and telegraph messages, is that of generating power for motion. The trolley car has come to be well nigh universal, while more and more is steam, as a direct motive power, giving way to electricity. To generate electricity in great quantities the dynamo or generator is used. For door bells, most telephones, and several other uses, the galvanic battery serves the purpose. This, in its simplest form, consists of a glass or earthenware vessel, in which vitriol, sal ammoniac and similar chemicals act upon zinc and copper. The dynamo, as well as the static electrical machine, works on the frictional method.

THE DYNAMO.

The dynamo is a device arranged with a central revolving part which is generally operated by a belt driven by a steam engine. Pressing against the armature, or revolving part, are brushes of metal. The rapid revolution of the armature excites a flow of electricity. This current may be controlled and sent in turn to trolley cars, to electric heating apparatus, to motors for running all sorts of electrical machinery, to electric light plants, or what not.

THE TROLLEY-CAR MOTOR.

The trolley car is one of the most common agents of the public, which uses electricity. The principle on which they are operated is very simple. Located on the car is a motor—more often two motors, quite similar to the dynamo which generates the electricity in the power house. Just as the revolution of the armature of the dynamo generates electricity, electricity when applied to the armatures of the motors on the car, will cause them to revolve. The electricity comes traveling down the trolley wire and on contact with the trolley on the car, shoots down into the mechanism of the car. On the platforms of the car are the controllers—metal boxes with handles attached to them. These handles control the flow of the fluid into the motor, and allow it to flow at full speed, or direct its course forward or backward. Here the circuit can be broken entirely. Now the motorman wants to start the car. The trolley pole, with its metal wheel in contact with the overhead wire, has brought the current to the controlling box. The motorman switches his handle around a bit, the current flows down to the brushes of the motor, and the armature which is attached to the axle of the car begins to revolve. The electricity, having done its work, passes out through a wire attached to the wheels, and flows along the rails into the ground, or back to the negative brush of the generator. As more speed is desired, the motorman throws the controller over a little further, and the car goes merrily on its way. To facilitate the discharge of the electricity after being used in the motor, wires of copper are run from the rails into the ground or return.

THE TELEPHONE.

The philosophy of the telephone is very similar to that of the phonograph, in so far as sound waves, impinging upon a thin sheet of metal, will cause it to vibrate. If

the metal vibrates near a magnet it causes its force to fluctuate, and thus generate electrical impulses through a telephone wire, according to the sounds which are directed against the metal. The electrical energy, therefore, is directed from the receiving end of the device. Many things are good conductors of these sound waves, but for convenience, wire is the best at present.

The telephone consists of an electromagnet, or, let us say, a coil of copper wire attached to a steel bar charged with magnetism. Close to the bar is a thin sheet of iron or ferrotype. This contrivance is connected with the wire to carry the message and acts with the electrical generating device. Now when sounds are directed against the ferrotype, it causes a break in the current of electricity which is imparted to the wire. At the other end of the wire, a similar device is receiving these impulses by the alternate attraction and cessation of attraction of the plate by the magnet, and the sound is produced.

THE INCANDESCENT AND ARC LIGHTS.

What should we do without the convenience of the modern electric lighting devices? To-day, all that is necessary is to turn a key or switch to flood darkness with light. Two kinds of lights are in common use—the incandescent and the arc light. The former is used principally for offices and residences, while the latter is used more for streets, factories and big halls. The incandescent lamp has reached a nearly perfect stage through the efforts of Edison. It consists of a hollow glass bulb from which all air has been pumped, and which is then hermetically sealed. Within the globe is a filament of carbon attached to little vises of platinum wire, which in turn connect with the electric wires. The principle which produces the light is that carbon affords high resistance to the current of electricity as it passes over the filament, and thus causes it to become incandescent. The filament is made of the fiber of bamboo carbonized. The length of the wire is regulated by the resistance required. The life of the lamp depends upon the ab-

FRANKLIN AND HIS KITE.

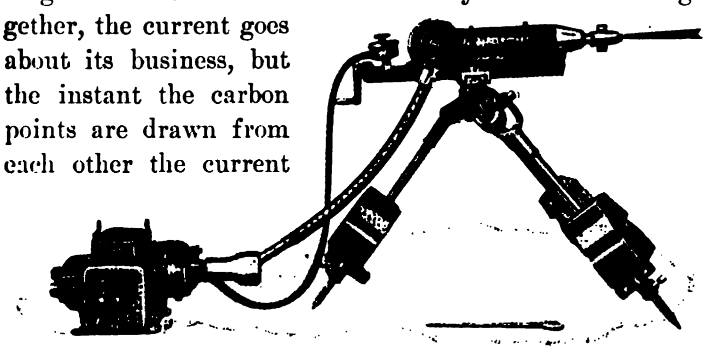
sence of air in the bulb, and in order to exhaust the bulb thoroughly when it is being manufactured, the exhausting process is carried on while the lamp is burning. A good lamp will last about 1,200 hours.

When some substance shall be discovered that will not burn away when the electric current passes through it, and yet will give out as strong a light as carbon, then the

feeding mechanism of the arc light, with its clutches, magnets, coils and wires, will be dispensed with. The arc lamp, with its intricate machinery, is necessary because no substance has been found so cheap and efficient as carbon.

POSITIVE AND NEGATIVE CARBONS.

When two pieces of carbon are held closely together, end to end, and a strong current of electricity is sent through them no light appears. But if the carbons are separated a short distance, an eighth of an inch, say, the current leaps across this space. Electricity always chooses the easiest path. So long as the carbons are held closely together, the current goes about its business, but the instant the carbon points are drawn from each other the current meets resistance, and in seeking to overcome this resistance, it generates heat. The heat soon causes the carbon points to glow, and the glow increases in intensity until the points become highly incandescent. In addition, the space between the heated points is filled with white, hot particles of carbon flying from the positive carbon to the negative carbon, and thus the electric arc is formed. The light is not made by the current of electricity itself, but is produced by the great heat generated because of the resistance made by setting up the air-space obstacle in the path of the current.



Courtesy of Gardner Electric Drill and Machinery Co., Cleveland, O.
GARDNER ELECTRIC ROCK DRILL.

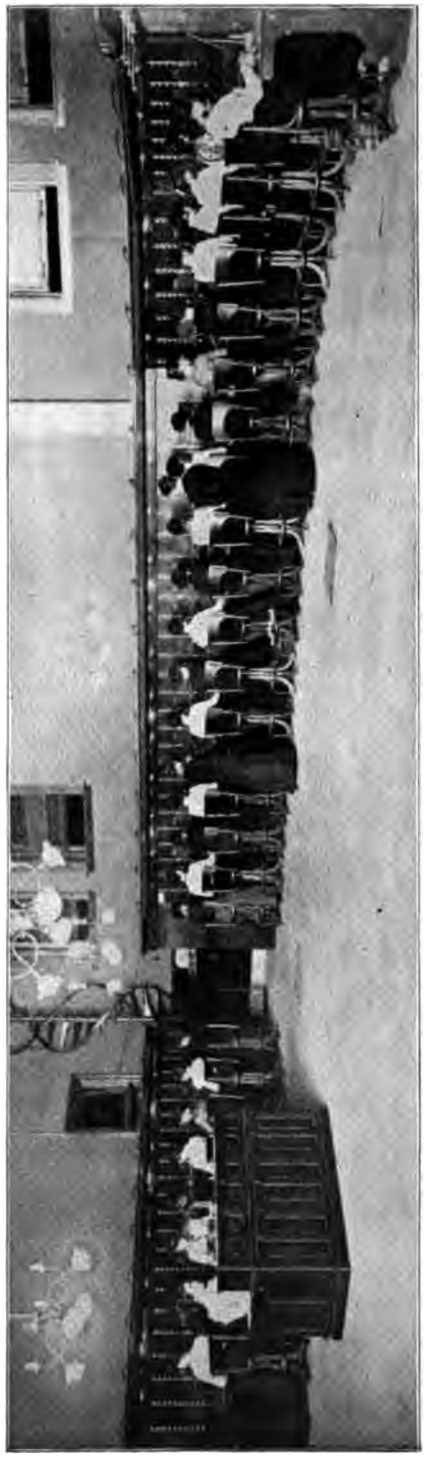
About 85 per cent of the light of an arc lamp comes from the positive carbon, 10 per cent from the negative carbon, and 5 per cent from the flame between the points. As the carbons are exposed to the air they gradually burn away and the distance between the points increases. In time, this distance becomes too great for the electric current to leap over, and the lights would die out if the carbons were not readjusted. The positive carbon burns away twice as fast as the negative carbon. In fact, a certain amount of the waste from the positive carbon is deposited on the negative point, and in this way the negative carbon becomes slightly pointed, and a crater-like hole is formed in the end of the opposite carbon. The heat generated by the leaping current is intense. When viewed through a smoky or colored glass, the points seem to be covered with little globular lumps, which appear and disappear as though the carbons were melting. The heat between the points is great enough to melt platinum, clay, granite and other substances, which can be melted only in the most intense heat, and in electric furnaces, by inclosing large carbon rods in fire brick and "striking" an electric arc by means of a strong current.

As the positive carbon wastes faster than the negative, it is placed above the negative carbon in the arc lamp and the clock work mechanism feeds it down, either continuously or at short intervals, so that the space between the points is always constant, and the lamp burns until the current is switched off or the carbons are consumed entirely. The regulating mechanism differs in the

various kinds of arc lamps, but all of them operate about as follows:

The current, before it reaches the carbons, passes through two electro-magnets, which control the feeding mechanism, and these two feeding or controlling mechanisms oppose each other. The current which supplies the carbons passes through one of these magnets, while another current branches off, and, passing through the other magnet, joins the former current where it passes out of the lamp, but does not go through the carbons. Ordinarily, but a small portion of the current passes through the coil of the second magnet, for it has a higher resistance than the first. When the carbons burn away, the resistance caused by the increased distance between the points becomes greater. If the resistance becomes greater than the resistance in the coil of the second magnet, the electrical current, which always chooses the easiest path, switches itself into the second coil, and thus the total current through the lamp is unchanged. Were it not for this arrangement, a failure on the part of the feeding mechanism of one lamp to keep the carbons at the proper distance apart would give so much current to that lamp that the other lamps in the circuit would be affected materially. The arrangement, however, not only prevents one lamp from affecting the others in the same circuit, but by the opposite movements of the mechanisms controlled by the two magnets, the carbon points are readjusted and the arc is brought back to its proper length.

The storage battery, whereby electricity is converted in such form that it may be carried about for use in automobiles, electric launches, etc., serves as a great convenience. The great objection to it is its

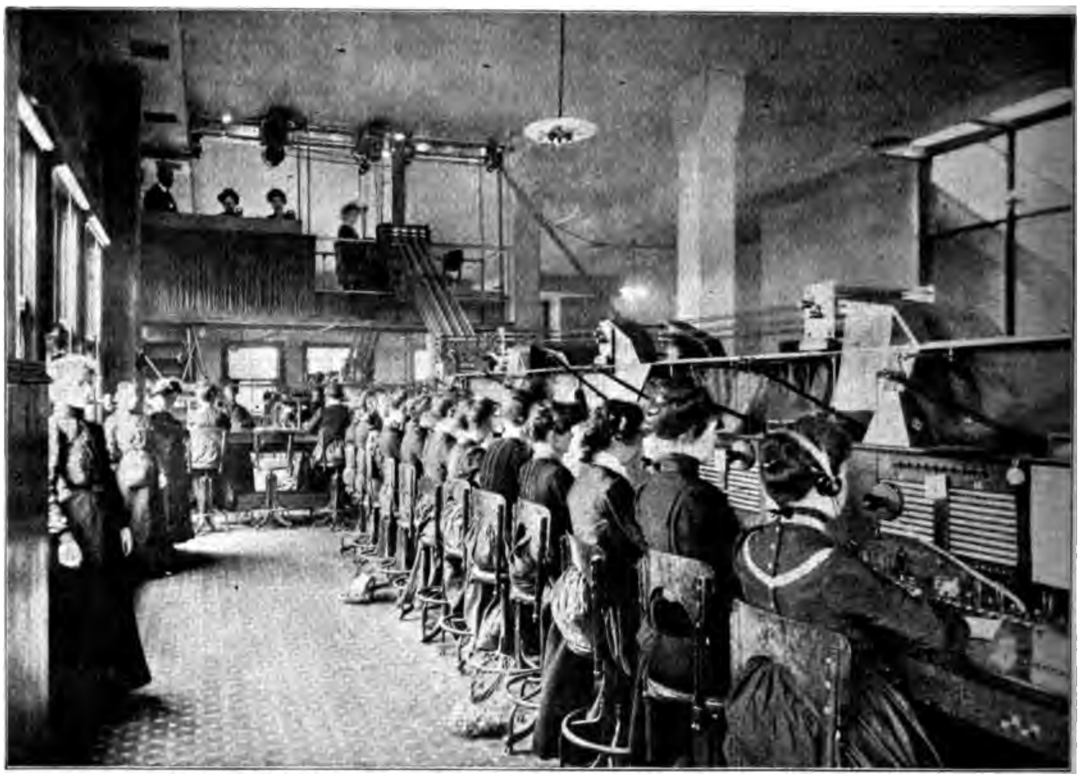


TELEPHONE—CENTRAL OFFICE, CHICAGO.

weight. To many people there seems to be much mystery as to the real character of a storage battery. Let us explain it away.

When two lead strips or plates are put into a bath of diluted sulphuric acid, and a current of electricity is passed through the solution from one plate to the other, a chemical action takes place. This results in the formation of peroxide of lead on one plate, and spongy lead on the other. Peroxide of lead is one form of a combination of oxygen and lead. If the electrical current is discontinued and a wire is made to connect the plates, a second chemical action will occur. And this chemical action will send a current of electricity through the solution of sulphuric acid and the water and the wire, but in an opposite direction to the original or "charging" current.

This current, however, will be of short duration, even though the charging current be considerable, because the surface only of the lead plates is affected by the chemical action, the first film of peroxide formed protecting the lead underneath from further oxidation. By repeating the process of charging and discharging, a practical storage cell can be made. Each "forming" tends to make the storage battery of greater capacity, for the "forming" eats into the lead, thus exposing more surface to be oxidized. The man who invented the storage battery was Gaston Plante, a Frenchman. He made the first one in 1859, but too

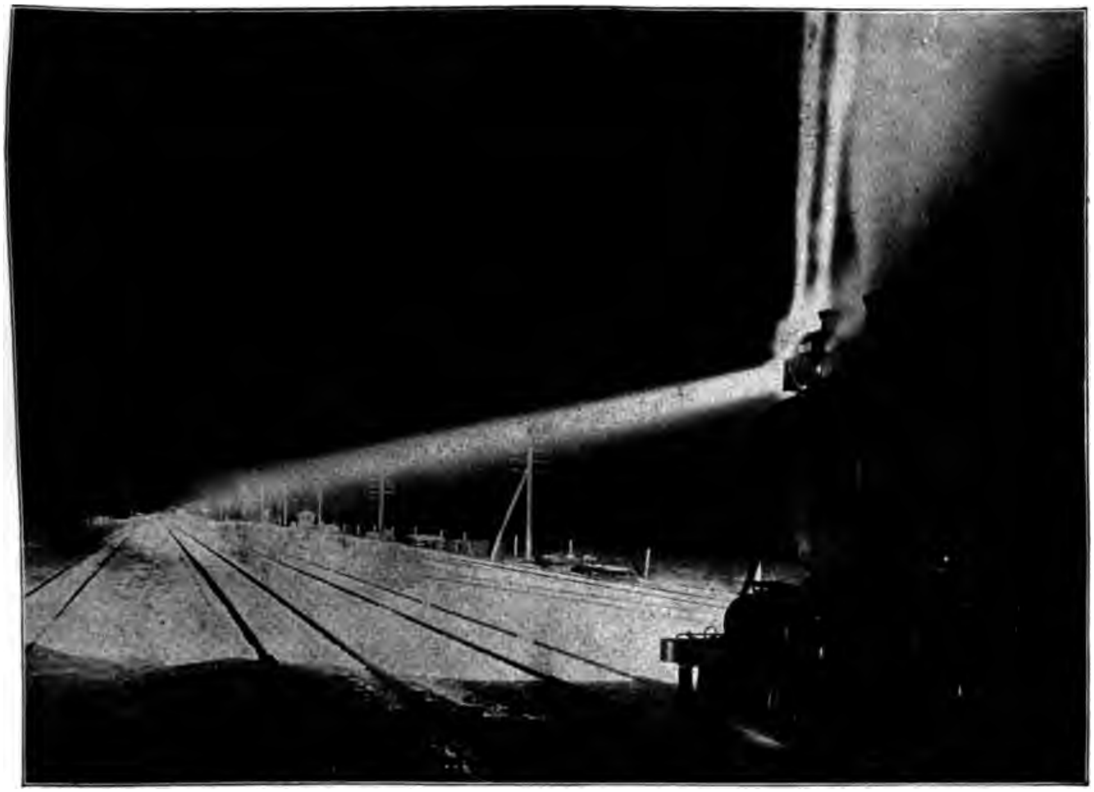


CENTRAL OFFICE, TELEPHONE EXCHANGE, CHICAGO.

much time was required to "form" the lead plates, or electrodes, six months being necessary for the alternate chemical action which put the plates into what might be called good storage condition. By that time the lead was so badly corroded that it fell apart, and the six months' labor was lost. Twenty years later, Camille Faure, another Frenchman, discovered that by pasting the "active" coating on the sheets of lead in the shape of oxide of lead, a storage battery could be made in a few days instead of months. His discovery caused considerable commotion in the electrical world.

A further improvement came when the lead plates were molded into "grids" or lattice-shaped plates, and red lead was placed in the square openings. The loaded "grids" are placed in diluted sulphuric acid, and the charging current changes the red lead on one plate into spongy masses of metallic lead, and on the other, into a like spongy mass of peroxide of lead.

Still another kind of battery is made of a series of horizontal strips of rolled lead a half inch wide, with grooves cut in them.



ELECTRIC HEADLIGHT USED ON THE C., M. & ST. PAUL RY. TO DETECT OBJECTS EIGHT MILES DISTANT.

The growth of electrical experiments has brought about many marvelous phenomena. Attempts have been made to make Nature turn out of her course and produce results in many phases of life before the time for maturity. Thus experiments on eggs to

THE PHOTOPHONE — THE LATEST SCIENTIFIC MIRACLE.
Telephoning on a Ray of Light Without Wires.

make them hatch quickly have resulted in fowls of abnormal size and monstrous shapes. In forcing vegetable growth the result has been more favorable. Especially is this true in maturing seeds by electricity. By using glass cylinders covered with copper disks, through which the current will flow into moistened seeds within the cylinders, growth is stimulated. After this treatment the seeds are put in a germinating pan which consists of two plates, one within the other, the inner one being of porous clay. The seeds are placed in filter paper between these, and are kept at a heat of 48 degrees by an electrical device. The result has been very profitable, the growth being 30 per cent quicker.

NIKOLA TESLA.

Nikola Tesla, one of the greatest of modern electricians, has succeeded in throwing waves across space and directing the movements of miniature war vessels in a tank of water without the aid of wires. He is working on a method of producing and conducting light without wires.

SENDING PICTURES OVER WIRE.

Sending pictures over wire has been achieved by a method called telepantography. By it fairly good pictures may be transmitted. The process consists in making a metal plate similar to that in halftone engravings so formed that they may be bent around a cylinder. The transmitting machine by means of a needle-like affair, somewhat similar to a phonograph, traces along the lines of the plate and imparts a stimulus to a similar machine miles away, which, equipped with an inked needle, traces out a picture in replica of the engraving at the sending end.

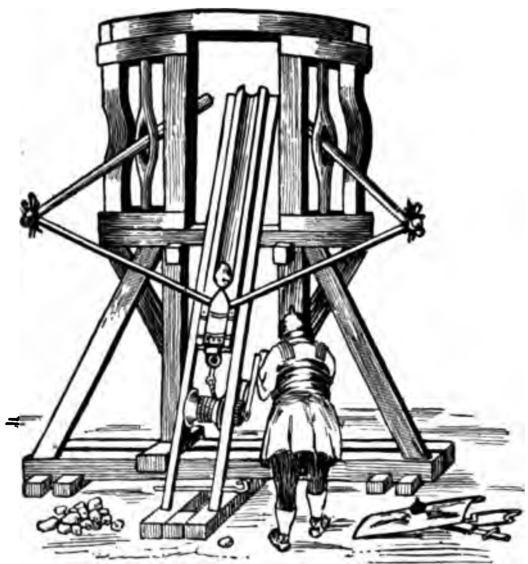
TRANSMITTING SPEECH BY LIGHT BEAMS.

Experiments in the transmission of speech by means of light beams were first made by Professor Bell some time ago with an apparatus called the "Photophone." The transmitter consisted of a plain mirror so arranged as to reflect the light upon a selenium cell in circuit with an ordinary receiver at the opposite station. The mirror served as a telephone diaphragm, a resonating chamber and mouthpiece being placed at the back. Speaking in the mouthpiece vibrated the mirror, the vibration altering the intensity of the beam of light. The changes in the light beam resulted in the selenium cell (acting with its well-known property of altering its electrical resistance under influence of light) setting up corresponding changes in the receiver circuit, and so producing vibrations in the receiver diaphragm like those communicated to the mirror of the transmitter. Professor Ruhmen, of Berlin, has improved somewhat on Bell's device, but the same principle is retained and the system is successfully used on warships of the German navy.

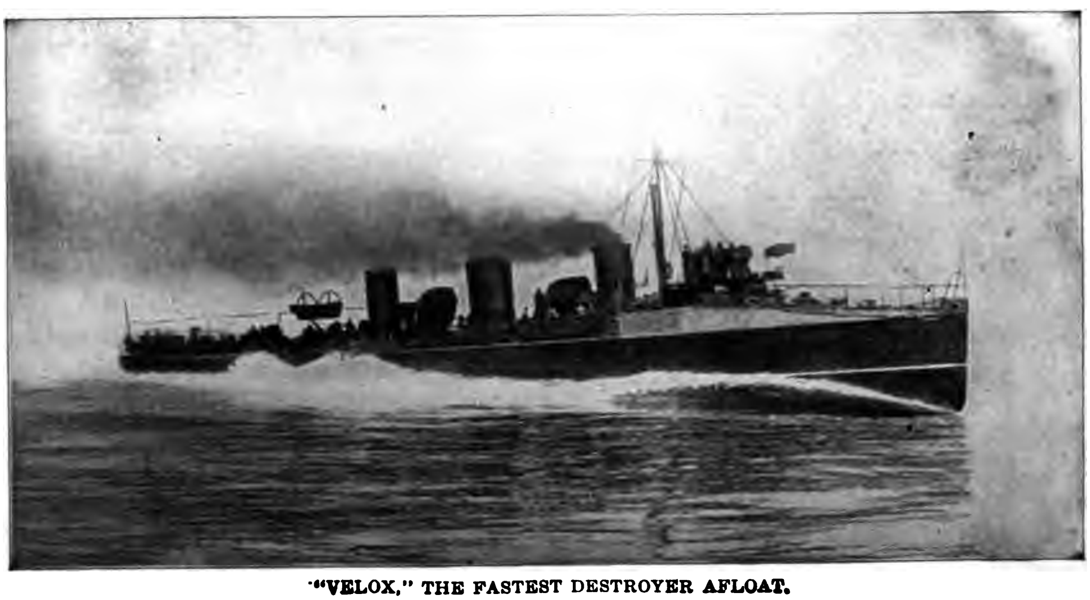
It would seem as though we now have the germ of a means of inter-planetary communication.

LATEST MACHINES OF MODERN WARFARE

Two great wars of recent date, the one between the United States and Spain and that between the Boers and Great Britain, have served one purpose, if nothing else,—that of showing how terrible can be the destruction of modern inventions of war. The stride made in a century in the development of war vessels, guns, explosives and methods of warfare has been marvelous. No longer do we hear of the frequent hand to hand conflict, of grappling chain and cutlass on war vessels, and the practical use of the bayonet. One would fain believe that with the awful examples set, universal peace, as proposed by the Czar of Russia several years ago, might not be mere illusion.


ROMAN CATAPULT FOR THROWING STONES.

In use for land forces some of the greatest improvements are the deadly machine guns, the rifle with great range, the high explosives, such as gun cotton, nitro-glycerine, smokeless powder, lyddite and cordite, and the cruel "dum-dum" bullet. These inventions almost preclude anything save long


"VELOX," THE FASTEST DESTROYER AFLOAT.
Speed, 33.64 knots.

distance firing and a rare gallant charge by the cavalry. On sea the changes have been even more marvelous. No longer do we see the old wooden hulls of vessels pierced by common round shot from the simple old cannon, of smooth bore. Nowadays, electricity operates nearly everything on shipboard, from lighting of cabins and searchlights to the propelling of torpedo-boats and firing of mines, guns and other weapons. So nearly perfect had armor plate been devised against the assault of ordinary explosives and gun charges, and so thick were the coatings of heavy hardened steel, that new devices were necessary to pierce them, and pierce them they do, at great distances and with tremendous force.

LYDDITE.

The explosives of high power that serve for force to drive the monster projectiles from the throats of the gigantic cannons of to-day, are numerous and terrific. One of the principal new inventions is lyddite—an explosive of the same class as dynamite, cordite, maxinite, melinite, etc. Lyddite is a mixture of picric brought to a state of dense fusion. This acid is given off by the action of nitric acid on carbolic acid. When a charge of this potent explosive goes off there is a deafening report, the outer coverings of the lyddite shells are ground into fine pieces and everything for a great distance around it is destroyed. This was used with deadly effect in the Boer, Japanese-Chinese and Soudan wars. During General Kitchener's campaign in the Soudan, a shell was dropped upon a temple of Mahdist worshippers and only twelve out of 120 there escaped alive. Cordite, discharged a twelve-inch shell into the Japanese flagship Matsushina, during the Chinese conflict, hurled a large gun from its mounting, fired a quantity of ammunition, disabled two other guns, and killed and wounded ninety officers and men.

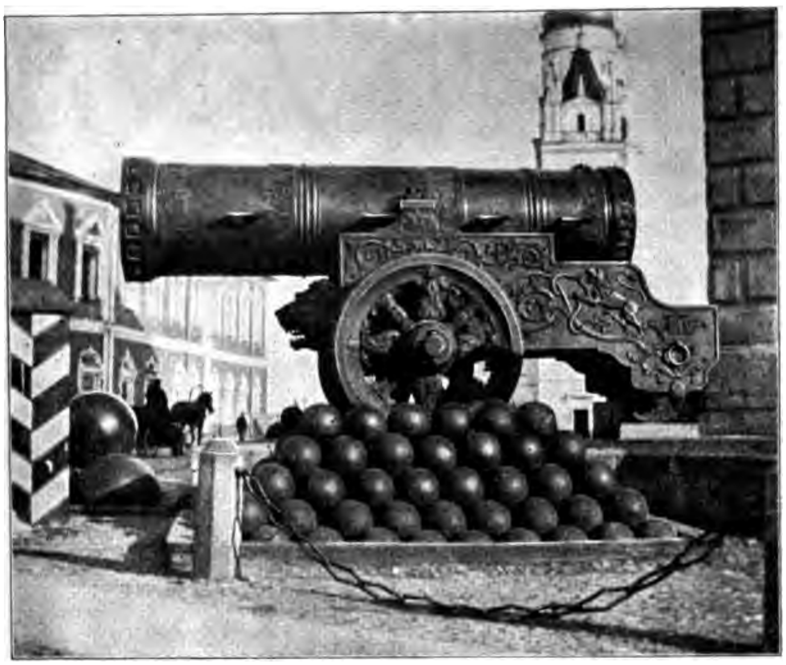
SMOKELESS POWDER.

Smokeless powder has for its main principle the quality of exploding without giving off a smoke, save a slight violet vapor that is hardly noticeable. This powder is made in long cylindrical strings and cut up into little pieces. In order to keep this explosive oily and to prevent its igniting by friction from rough handling, it is shaken in a receptacle containing powdered black lead, or plumbago, thus receiving a coat of the stuff. Some kinds of smokeless powder resemble strips of slippery-elm bark. This is made in slabs a foot or more in length, and about a quarter of an inch in thickness. This kind of powder is much more safely handled than ordinary black powder and will burn readily and without danger if a match is applied to it. The flame is steady and the powder does not flash off with a great splutter. Some of the stuff is cut up in chip shape. This will stand hammering; in fact, it is loaded into shells with a great deal of hammering. Cordite, as its name signifies, is made in long stringy shapes.

NITRO-GLYCERINE.

One of the best known of the terrible explosives is nitro-glycerine. This is used frequently for deadly purposes, but is more often used in commerce, for blasting rocks, wells, etc. In color, this explosive is generally a light yellow. It is odorless, has a sweet, pungent taste, and when placed on the skin will cause a headache. Its method of manufacture is somewhat as follows:

Into a large tank called an "agitator" is stirred a quantity of nitric and sulphuric acids, in equal quantities. The stirring is done by means of automatic, revolving paddles. After there are 25 pounds of the mixture, 1,500 pounds of sweet glycerine are added. At once the mixture rises rapidly in heat. Since it will explode at 90 degrees F., water pipes are provided about the agitator to keep the mixture cool. In carrying the stuff, there is great danger of spilling it, which would at once cause a terrible explosion. The life of the nitroglycerine maker is only about five years at his work. As in the factories of other powders and explosives, great care is taken that no metals are worn. The clothing and shoes of the employes must be changed frequently, so that gritting dust will not accumulate in them. Even canvas shoes must be worn, and the trousers of the working men must not be turned up for fear gravel might be gathered in them.

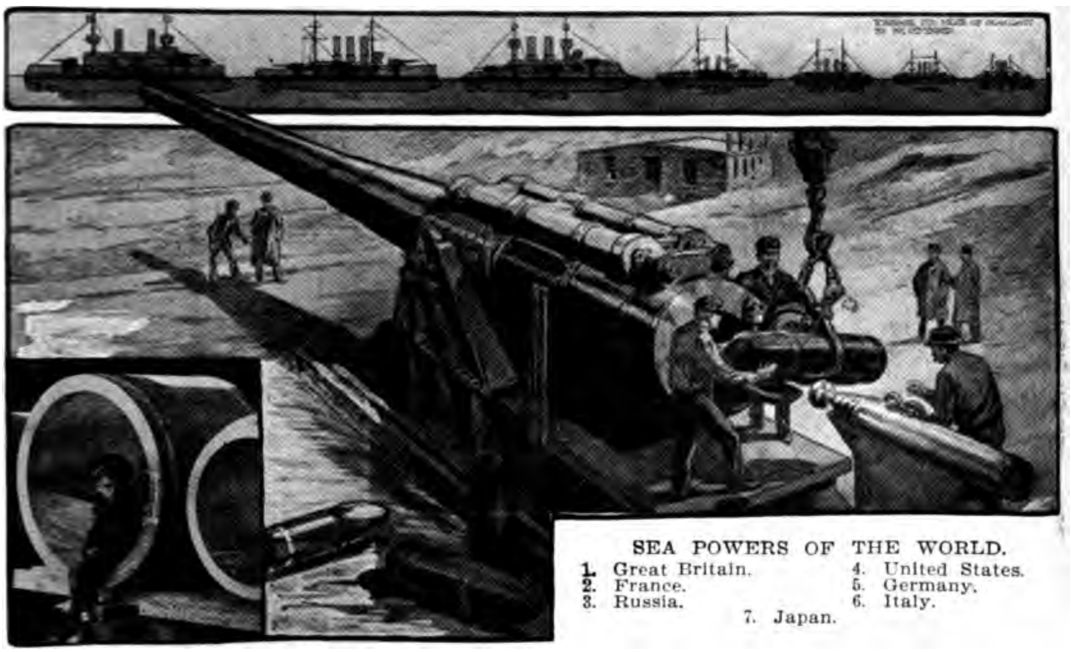


ONE OF NAPOLEON'S GUNS, IN THE KREMLIN, MOSCOW, RUSSIA.

THE "DUM-DUM" BULLET.

Progress in the matter of projectiles has taken two distinct directions, one toward ferocity, the other, oddly enough, toward gentleness in warfare. The aim in battle generally is simply to disable the enemy. There is not a general desire to maim for life. Therefore, if a bullet cannot kill a man outright, it is better that it hurt him as little as possible. This is the effect of some of the better smooth balls fired from the modern small rifles. Men have even been known to be pierced by such bullets without serious injury. On the other hand, such affairs as the "dum-dum" bullet are atrocities for cruel intent. This bullet is driven by charges of cordite. The inner part of the bullet is made of soft lead, but it has a thin outer sheath of hard nickel or copper. Its end is cleft downward for a short distance. Thus, when this bullet strikes its victim, man or beast, the soft lead expands while the covering breaks jaggedly, inflicting terribly painful wounds. Another monstrous invention is known as the base shell. This is a contrivance for firing from a big cannon, the ball having a base separate from the head.

This base is on ball bearings and is equipped with four scythe-like knives which fold up on the side of the ball until it is discharged. When the shell starts on its errand of carnage, the rifling of the gun starts the pointed part of the shell to revolving, but the base stands stationary. The knives spring from their places and cover a diameter of 45 inches. It may be imagined what havoc these blades would



SEA POWERS OF THE WORLD.
1. Great Britain. 2. France. 3. Russia. 4. United States. 5. Germany. 6. Italy. 7. Japan.

work in a close line of infantry. And, even then, the work of the shell is not complete, for when it strikes it explodes. Other projectiles for naval warfare, weighing thousands of pounds, are made of hardened steel and will pierce the immense armor plates of the battleships with apparent ease. Most of these explode after striking.

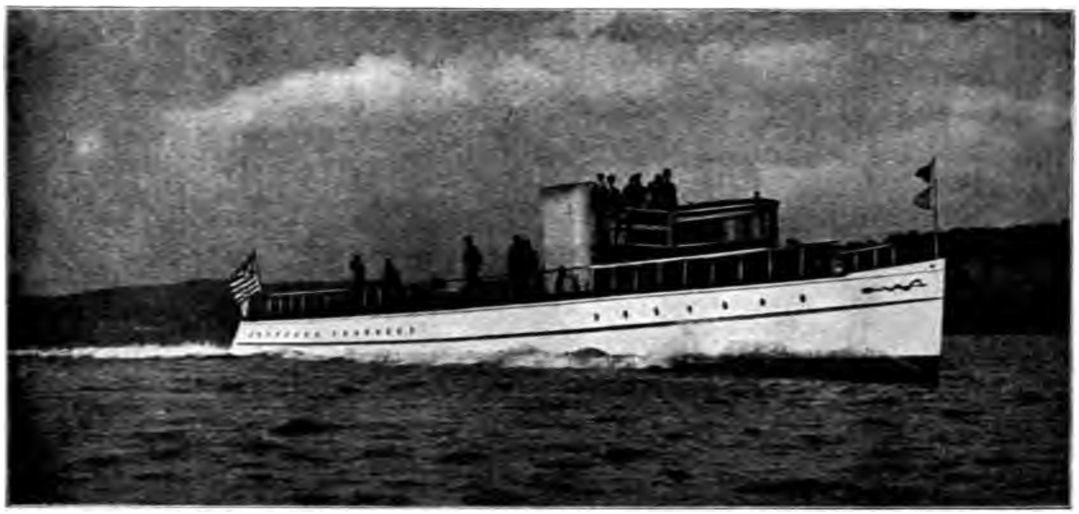
TORPEDOES AND MINES.

Torpedoes and mines are the dread of the navies of the world. The havoc they work is great and terrible. The former is built in the shape of a cigar, loaded with guncotton or dynamite in the point of the nose. Within the device is an electric storage battery attached to a propeller at the rear, which will drive the death-dealing machine boat through the water to the enemy's ship. When one of these torpedoes is to be discharged the electricity is turned on, the rudders adjusted so that the machine will go in a given direction, and then it is shot out of a compressed air device toward the enemy. It travels with little noise and great speed, and when it strikes an object its cap discharges its load of dynamite and wrecks everything within touch. During both peace and war important harbors are dotted over with submarine mines or bombs of great explosive force. These are connected with the shore by electricity so that they may be fired off at will many miles from the man who operates them. Some, also, float upon the surface and go off on contact. For those fired

by electricity charts are made, showing the exact location of every one. By looking through a telescope the operator, miles away, can tell just when the enemy's vessel is over a certain mine. A switch is then turned, and the ship is blown to atoms.

THE GATLING AND HOTCHKISS GUNS.

The machine gun works deadly havoc either from the crow's nest or fighting top of a ship, or on the battlefield. Among the terrible engines of war those most prominent are the Gatling, Maxim and Hotchkiss guns. The first-named is constructed of a number of barrels joined together side by side so that at a distance the whole contrivance looks like a big, stubby gun. Generally about ten barrels make up one gun, and all revolve upon one central pivot. Each chamber has a separate lock which discharges the cartridge when the barrel reaches its proper position. The affair works by a crank and the cartridges are allowed to slide from a rack down through grooves into their chambers, and are ejected automatically as soon as discharged. About 1,200 shells a minute can be fired from a Gatling. The Maxim is entirely self-acting after the first discharge. The cartridges are loaded into the gun on a belt, and all the gunner has to do is to pull the trigger for the first shot, and keep aim. The recoil is sufficient to open the breech, throw out the empty shells, admit a fresh shell, cock the gun and fire it again. A belt with 600 cartridges can run through the gun in a minute.



STEAM YACHT "ARROW," FASTEST CRAFT IN THE WORLD.
Speed, 39.13 knots.

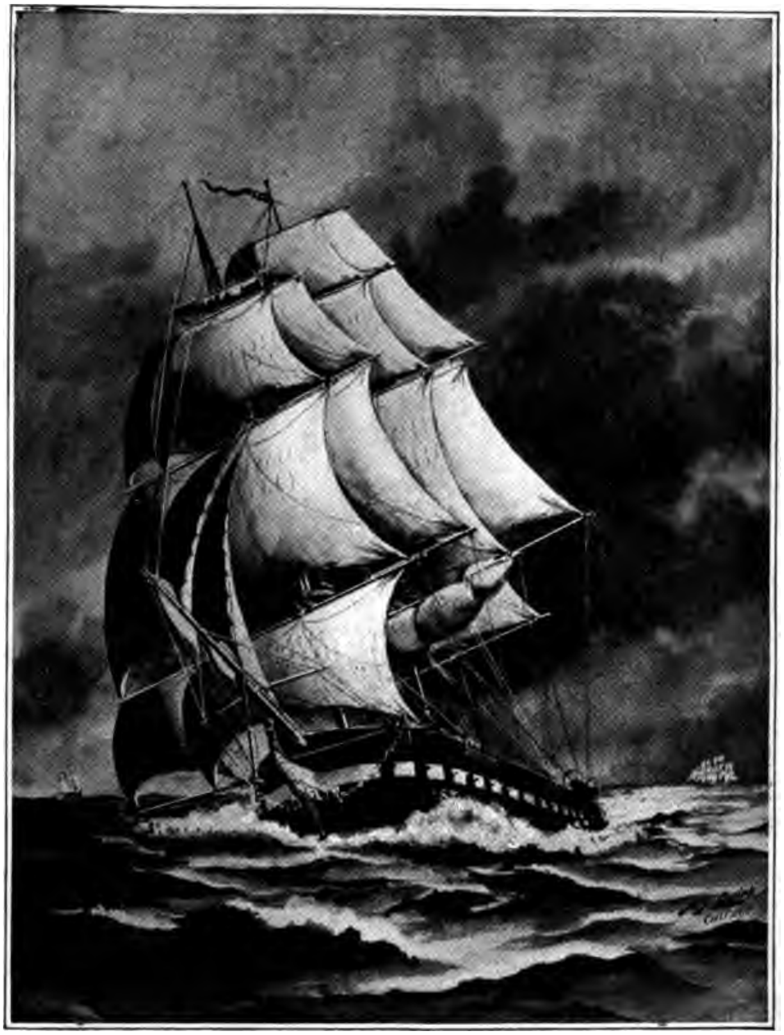
THE ARMSTRONG GUN.

The largest calibered rapid-fire gun is the Armstrong, which uses 4½ pounds of smokeless powder at a discharge, and throws a six-inch shell weighing 100 pounds with enough power to go through fifteen inches of wrought iron. Smaller guns of the same order throw forty-five-pound shells at the rate of fifteen a minute. The Hotchkiss and Driggs-Schroeder rapid-fire guns were invented by Americans and

were designed principally for the fighting-tops of war vessels. They are swung on pivots, so that they may be thrown in any direction. This gun is fired shot by shot, but 36 shells a minute can be sent off with great force. The gunner steadies the gun by pressing a butt to his shoulder, like an ordinary fowling piece. He thus has his arms and hands free to aim the gun, load and fire it.

THE SEARCHLIGHT.

Of great use in modern warfare as well as in commercial marine service is the searchlight. Nowadays, nearly every steam-driven vessel is equipped with one or more of the great lights. In war they are serviceable in locating the enemy at night, in detecting the movement of torpedo boats, and in directing vessels by signals. In commerce they aid in signaling, in lighting the path of the vessel, and in rescuing people who fall overboard. They are used in light-houses, and even fire departments in the great cities use them to light up dark buildings where the firemen must go. Some of these lights throw beams many miles. Generally they are made of lenses and reflectors that will collect and send out the light of a 25,000-candle-power electric arc lamp. They are constructed in cylindrical shape about a yard deep, and nearly of the same diameter. In the back are silver-back reflecting lenses of great power, and powerful reflecting lenses are placed in the focus of the beam of the enclosed electric light.



TYPICAL AMERICAN WARSHIP OF EARLY TIMES.

U. S. Frigate "Constitution" ("Old Ironsides"), built in 1809, reeling off 13½ knots an hour—a speed greater than that of the racing yachts of today.

Both of these lenses collect and concentrate the light and throw it far out upon the night. The rays are kept so close together that nearly a mile away the width of the projected beam is only about fifty feet. The whole device is poised on a revolving pedestal and can be moved in any direction desired. One of the largest of these great searchlights was exhibited on the roof of the Manufacturers' Building at the World's Columbian Exposition at Chicago in 1893.

LAUNCHING OF THE ARMORED CRUISER "COLORADO."
Illustration shows vessel leaving "the ways" at Cramp's shipyard, Philadelphia, April 25, 1903. (Opposite picture represents her completed and cruising at sea.)

It has since been installed in the observatory on the summit of Mount Lowe, California. It has a power of 3,000,000 candles, and throws a brilliant light 150 miles. Its huge reflecting lens weighs 800 pounds. This lens is three-quarters of an inch thick at the edges, and one-sixteenth in the center. The whole light weighs 6,000 pounds, is 11 feet high, and yet so delicately is it poised that a child can direct it at will.

MAKING OF ARMOR PLATE.

America makes by far the best armor plate in the world. The process of converting crude iron ore into the monster hundred-ton plates of steel, two feet thick, for the sides of battleships, is very interesting. At South Bethlehem, Pennsylvania, is located the great modern plate-making plant. Here have been mastered so perfectly the great forces of nature that masses of metal so great as to seem almost immovable are handled with great simplicity. After the combination of pure iron and carbon which makes steel has been blasted free from impurities, and the metal has been shaped into glowing ingots, the open

hearth system is resorted to to shape the great hot masses into proper form. The reason for using an open hearth is on account of the great heat generated for making the armor plates. Sometimes pig iron is brought to the furnace and there mixed with scrap steel or other ingredients, to turn it into steel. No other enclosure for the steel is needed than the bare walls of the furnaces. Here the steel is subjected to about 4,000 degrees of heat. This intense heat is obtained by first treating coal with a great heat in air-tight ovens, where there is but a limited supply of oxygen. This causes an intensely hot gas. This fiery gas passes through firebrick channels that open upon the hearth where the steel is waiting. When the supply of fresh oxygen in the air meets this gas it bursts into flames instantly. The combustion is terrific and the iron and carbon or scrap steel are converted instantly into a flaming mass, while a heat of sun-like force is thrown off.

THE LARGEST CRUISER IN ACTIVE SERVICE.

U. S. S. "Colorado" at full speed.

Description.—Length, 502 feet; beam, 59 feet 6 inches; speed, 22 knots; horsepower, 23,000; battery, four 8-inch R. F. rifles, fourteen 6-inch, eighteen 14-pounders and twelve 3-pounders; cost, $3,780,000.

The spare gas from this furnace is carried off through another firebrick passage, together with the hot air of the hearth. This passage opens upon another open hearth just opposite from the one in use. The spare heat thus keeps both warm, and in order to save the heat these passages are used reversely every twenty minutes, each keeping warm for the other, when its turn comes. This method saves a great expense. At South Bethlehem eight of these

THE U. S. CRUISER "GALVESTON."

Only Type of New Style Naval Vessel, with Sails for Motive Power.

Class of six ships designed for "police protection" to the rapidly extending interests of this country.

Vessel is officially termed "an improved model of the 'Raleigh' class of cruisers," which were built when the craze for speed at any price was at its height, and is a "stayer" rather than a "flyer," having coal capacity to steam 12,000 miles. This, with her sail auxiliary power, renders her independent of many coaling stations and fits the ship for longer voyages than is possible with any other type of the new navy.

Description.—Speed, 16½ knots per hour; length, 308 feet; beam, 43 feet; displacement, 3,400 tons; battery, ten 5-inch, eight 6-pounders, two 1-pounders, and two Colt rapid-fire guns. Sail area, 6,000 square feet of canvas.

open-hearth furnaces are in use, four capable of handling forty tons of metal each, and the other four, half as much.

When the proper heat has been secured and the melting and mixing of the steel has gone far enough, the fiery liquid is run off from the hearths into great caldrons which run on rails. Thence the metal is ladled off into molds that also run on tracks. When the steel is poured into the molds there is no splashing, for the metal runs gently through a tube into the mold, which fills up bottom first. This process is called bottom filling and prevents bubbles and other inequalities in the steel when finished. Further precautions against impurities from gas, etc., are taken by having the inner lining of the molds made of a sort of steel lath-work covered with sand. Thus the gas escapes from the hardening steel without marring its grain. The hardening process differs from the old-style method of hammering by which many flaws were occasioned. At the Bethlehem works "fluid compression" is used—that is, a great weight from hydraulic presses is put upon the steel while it is yet hot. Sometimes, this pressure equals 7,000 tons.

Great ingots from which guns and crankshafts for ves-

sels are to be constructed often weigh 120 tons and take days to cool off. After they are cool enough to handle, great traveling cranes, with which the works are equipped, pick them up and transport them to other furnaces where they are heated over again in a temperature of over a thousand degrees Fahrenheit. These cranes are great heavy machines weighing about 175 tons, and needing 1,500-horsepower to operate them. In the reheating process, great care must be exerted not to crack the ingot. Then another pressure of about 28,000,000 pounds is brought to bear on the metal in a hydraulic shaping press. This method of tempering hardens the metal clear through, and not simply a few inches from the surface, as was the case with the hammering method. This is much better, for it gives the proper strength to withstand the great forces brought to bear upon armor plates, gun barrels and crankshafts. After several treatments of extreme heat and pressure, the tempering is finished by annealing, or by suddenly plunging into oil to prevent crystallizing.

THE SWIFTEST BATTLESHIP AFLOAT.—U. S. S. "MAINE."

Namesake of the ship destroyed at Havana, February 15, 1898, when 254 lives were lost in the service of the country.

The new vessel embodies all improvements suggested by experience in actual battles of the last ten years, and is the leading ship of her class in the navies of the world.

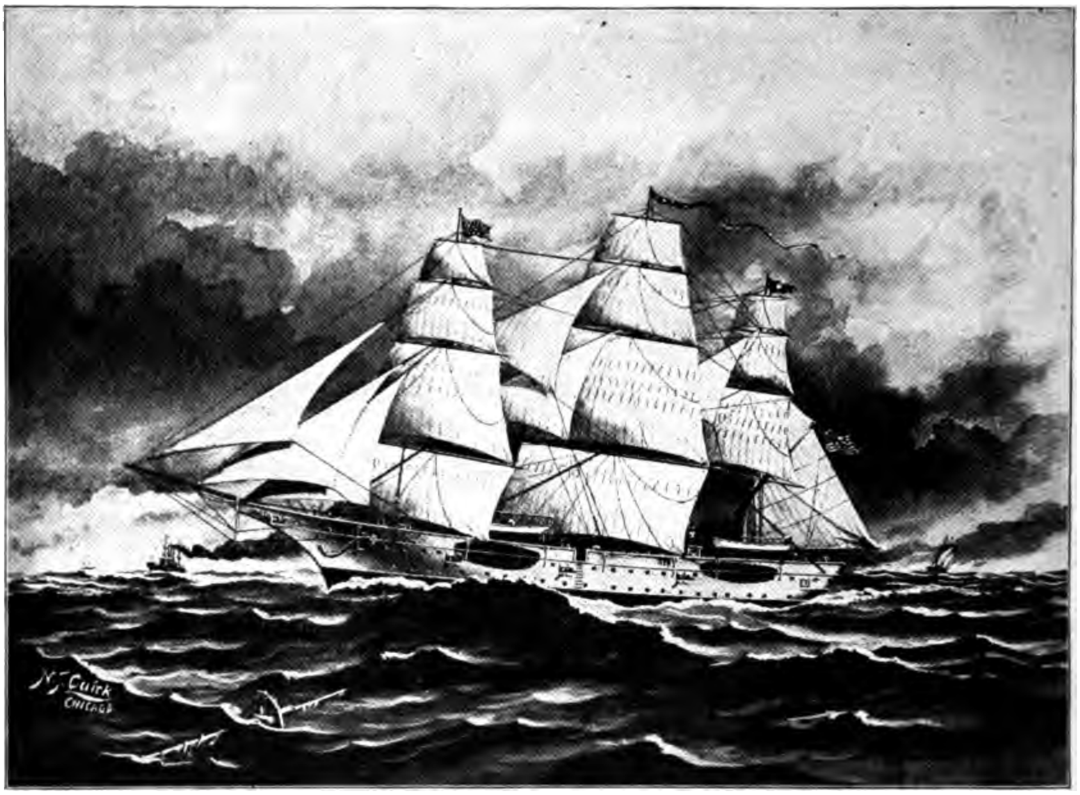
Description.—Speed, 19.95 knots per hour; length, 388 feet; beam, 72 feet 5 inches; displacement, 12,500 tons; horsepower, 16,000; crew, 600; cost, $3,000,000; battery, four 12-inch rifles, sixteen 6-inch and twenty-four smaller guns, all of rapid fire.

Ship was launched at Philadelphia, July 27, 1901.

After this hardening it might seem that the steel turned out would be so hard that it could not be altered in shape. Science, however, provides great shears, buzz saws and lathes which will turn the steel into desired shapes. The saws are 84 inches in

diameter and are equipped with 76 inserted teeth. This saw can run through a steel plate 33 feet long and two feet thick. Lathes for turning guns and crankshafts for ships will turn great blanks and pare them as desired. Armor plates are shaped by being put under great hydraulic presses which exert tremendous power and will bend the plates to fit the ship for which they are intended.

These plates must undergo severe tests before they will be accepted for service in the navy. Government officers supervise all the work of casting and tempering to see that it is done right. These men select the seemingly poorest plates and test them. The testing is done on a special ground, and consists of firing heavy shells at the new armor from a short distance. Sometimes, the armor is only slightly scratched; again, the balls go through cleanly. If the testing plate stands the ordeal, the whole batch is accepted for the armor of some warship. If two plates fail all the casting is thrown out at the cost of the contractor, and a new set must be made. The best armor plates have been devised after plans by Harvey and by Krupp, the great gun makers. The surface of the plates is generally full of little odd seams and lines, but



A NEW NAVAL NURSERY.
The U. S. S. "Chesapeake."
Her value to the U. S. Naval Academy proven, the Government authorizes three more of her class.

this does not mar the impenetrability of them.

SIX NEW BATTLESHIPS.

Since the Spanish-American war there have been great advances in the building of warships. Many new craft have been added to our navy. Six new monster battleships of the finest type have been provided: the Alabama, Kearsarge, Kentucky, Illinois, Maine and Wisconsin. The measurements of the Kentucky and Kearsarge will serve to indicate the size of our new naval equipment. The water-line length is 368 feet; displacement, 11,525 tons; horsepower, 10,000; speed, 16 knots an hour; water-line armor belt, 16½ inches; side armor above the belt, 6 inches; turret armor, 17 and 15 inches; conning tower, 10 inches; protective deck, 2¾ inches. The armament consists of a main battery of four 13-inch guns, a secondary battery of fourteen 5-inch, rapid-fire guns, and twenty 6-pound rapid-fire guns. The sub-main battery has four 8-inch guns. The main battery projectiles weigh 1,100 pounds, leave the muzzle with almost incalculable energy, and have the penetrating power of piercing 34½ inches of wrought iron.

Experiments to disable a balloon in the air by rifle or field gun fire have been carried out by the Austrian army. A balloon 7,000 feet high was held at anchor, and the gunners, kept ignorant of the range, were told to disable it. Twenty-two shots were fired before the approximate range was found, and it was only at the sixty-fourth round that the balloon was hit, and that slightly, but the small rupture of the gas bag made it slowly descend.

A SLOT MACHINE THAT TAKES PHOTOGRAPHS

The latest thing in slot machines is one that will take your photograph, develop it, and present it to you in a frame, with a pin attached to the back affixing it to a garment—all in just two minutes, by the watch. This is just now being installed in every railroad station of importance and in other public places where a harvest of nickels is to be gathered.

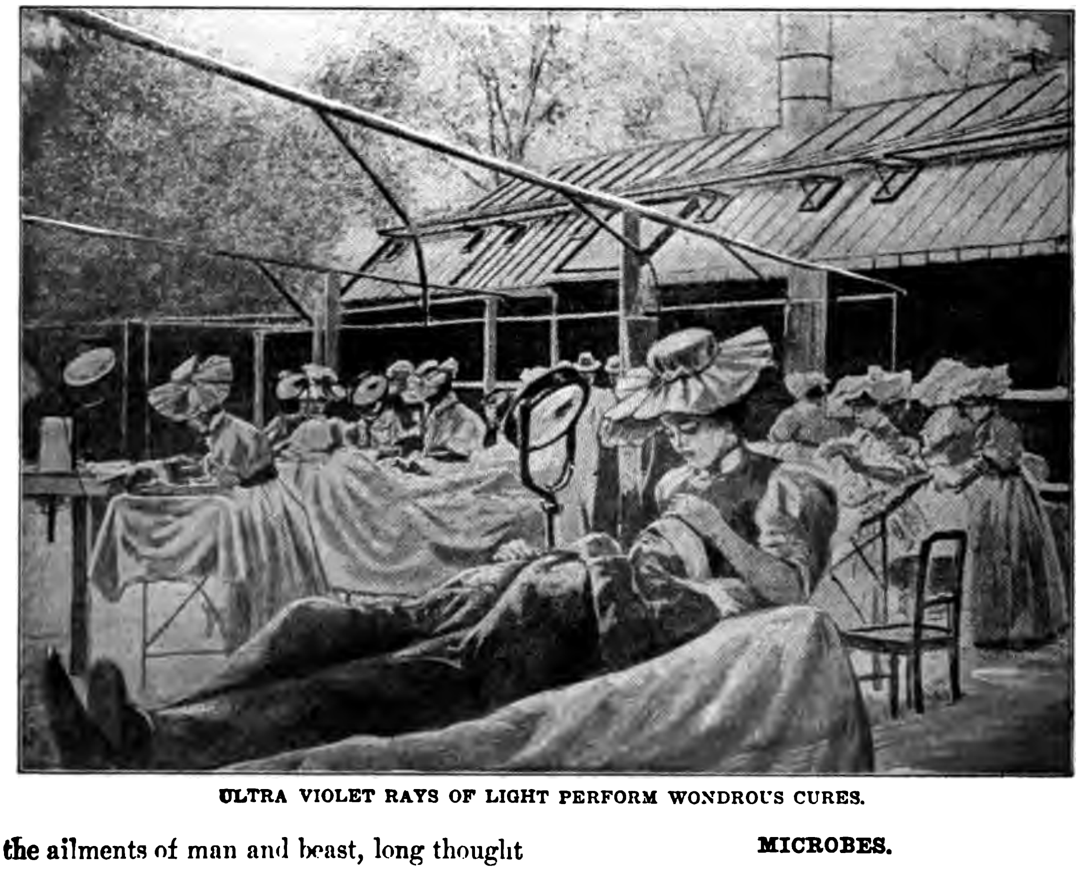
In order to have your picture taken, you drop a nickel in the slot and then detach from the machine a handle, which retains connection with the apparatus by a wire. Then you sit down in a chair, still holding the handle, and observe yourself in a small mirror placed for that purpose in front of the machine. When you have the proper attitude and expression you press a button in the handle, and immediately a brilliant electric light is flashed upon you. At the same time a bell rings, and continues to ring while the exposure lasts.

The exposure is only about two seconds, during which, of course, you are expected to remain perfectly still. You may then get up from the chair and relinquish the handle, inasmuch as the machine will do the rest. The plate which has been exposed is automatically immersed in a developing bath, where it remains for five seconds. Out of this it slides into a fixing bath, where it lies for 25 seconds. Then it goes into a chemical wash for a few more seconds, and, emerging therefrom, is almost instantly presented to you, framed as aforesaid, and with a pin at the back.

Of course, the plate is developed not as a negative, but as a positive. Furthermore, it is already contained in its little frame, with a pin attached, when it is put into the machine. Hence no time is lost supplying the frame with the portrait, and the latter is produced complete inside of two minutes. The chemical wash which succeeds the fixing bath is, of necessity, a prompt drier. This novelty is the invention of a Cleveland, Ohio, genius. The price of the pictures is a nickel each.

NEW DISCOVERIES IN THE FIELD OF MEDICINE AND SURGERY

While progress has been made in the realm of mechanical and commercial discoveries and inventions, means have been devised through the aid of science to heal scientific branches, have forged ahead steadily until to-day thousands of people owe their lives to the march of progress in these scientific efforts.



ULTRA VIOLET RAYS OF LIGHT PERFORM WONDROUS CURES.

the ailments of man and beast, long thought incurable. Men of medicine and surgery, spurred on by marvelous discoveries in the sphere of electricity, bacteriology and other

MICROBES.

It was comparatively only a few years ago that science learned that the common source of many diseases before attributable

to numerous causes was the existence of microbes or bacilli in the human system. These microbes are tiny animal creatures which feast on the healthy tissue of the body and waste it away. So far has science gone that bacteriologists have discovered that different kinds of microbes produce different kinds of diseases. They have even raised these animalculæ, experimented with them, classified them, and by careful study have found treatment that in many cases will annihilate them.

CONSUMPTION.

The fight against tuberculosis or consumption of the lungs has been a hard and discouraging task. Numerous methods have been used with scant success. One, of recent date, has been efficacious to some degree, and is the discovery of Dr. J. B. Murphy, of Chicago, who invented the Murphy button "for patching together severed intestines." Dr. Murphy pierces a diseased lung with a hollow needle, injects a gas which causes the lung to collapse, and then allows that portion of the lung which is diseased to get together. This makes the lung smaller, but through gradual use it will regain its former size.

DR. FINSEN'S TREATMENT — CONCENTRATED RAYS OF VIOLET LIGHT.

Some diseases of the skin which are caused by bacteria are treated by light. Dr. Finsen, of Copenhagen, has perfected a method of concentrating violet rays of light, which, when cast on diseased tissue, seemingly penetrate it with bactericidal effect. Some of the experiments along this line are interesting. Dr. Finsen exposed a bacillus culture to bright sunshine and found that the light killed it in an hour and a half. The same work could be done by electric light in eight hours. He discovered that when the skin was full of blood the light took a longer time to penetrate. He proved this by putting a piece of sensitized paper behind a man's ear and this, after a considerable exposure, was not affected by the light. When the blood was pressed away from the ear an exposure of 20 seconds turned the paper black. Fur-

By courtesy of Dr. Zeigler.

REDUCING LUXATION OF THE 11TH AND 12TH DORSAL VERTEBRAE.

ther experiments showed Dr. Finsen that blue rays of light would kill bacteria. In order, therefore, to concentrate these rays, he divided the lens, between the glasses of which he put a solution of bright blue, weak, ammoniacal copper sulphate. This served to absorb nearly all the rays except blue and violet, which were allowed to pass. These lenses are attached to the skin by rubber bands. Cool water is run over the glasses to prevent the heat of the rays from blistering the skin. The weight of the glass presses the blood away from the surface, and the violet rays quickly penetrate the skin and kill the germs. Smallpox, lupus or tuberculosis of the skin, and many other skin diseases have thus been cured.

LIQUID AIR.

We have described in another section of this book some of the marvelous attributes of liquid air. Its intense cold has the same property as great heat without causing a blister. Thus, naturally, the use of liquid air in some sorts of diseases where cauterizing or burning away is necessary has shown marked success. Putrid flesh is killed and foreign growth is removed by its agency. Ulcers have been eaten out and facial erysipelas has been cured by driving away the heat from inflamed tissues through rolling a glass bulb filled with liquid air over the face. Frequently it takes the place of the surgeon's knife.

THE X-RAY.

Almost every one has heard of the use of the X-ray for surgery. Although the discovery of the Roentgen ray is only of recent date, already marvelous operations have been performed which would not have been possible without its aid. By means of skiagraphs, or shadow pictures, taken with this all-penetrating light, bullets, blood clots on the brain, broken bones and the like have been located, and thus operations have been rendered possible. Frequently some foreign substance is present in the body of which no knowledge is had. Sometimes the skull is fractured slightly without the knowledge of the physician. The X-ray discovered these, as well as consumption in

By courtesy of Dr. Zeigler.

REMOVING TUMOR ATTACHED TO 5TH, 6TH AND 7TH CERVICAL VERTEBRAE.

No Anesthetics Used—No Pain Experienced.

early stages, ruptures and enlargement of the heart, stomach and other organs. One case, brought to light some time ago, was that of a patient who suffered pains near his nose. An abscess had formed and the skiagraph discovered a small sack in the cavity back of his nose, containing 32 miniature teeth. In the fight against bacilli, serums are used. These in the main

are procured by taking the blood of an animal inoculated with some certain disease. M. Pasteur has had remarkable success with his serum for preventing hydrophobia and the plague.

BUISSON'S CURE FOR HYDROPHOBIA.

In the Pasteur institute for rabies great numbers of people have been successfully treated for hydrophobia. There is much cruelty, however, in the system, for in order to keep the serum fresh, small animals, like rabbits, must be inoculated in large numbers. The Pasteur treatment does not cure hydrophobia; it simply prevents it.

Some scientists believe that hydrophobia cannot be cured, yet there have been cures of the rabies in their last stages, under the Buisson system. It is well known that the system of sweating by violent exercise, or by Turkish baths, removes impurities from the body. This is the system discovered by the French physician, Dr. Buisson, although it is said the Arabs have long known of this primitive cure. Commonly these nomads swathe themselves in heavy blankets of camel hair to cure snake bites. Dr. Buisson was called to treat a patient who was affected with the rabies. He bled her, accidentally cut his own finger and wiped it incautiously upon a handkerchief wet

By courtesy of the Lawrence Co.

OPERATING CLINIC OF THE NORTHWESTERN UNIVERSITY DENTAL SCHOOL.

Patients are treated free, for the practice the students get.

with the patient's saliva. Although he cauterized the wound, he was seized so violently with the disease that he thought death was near. Knowing that a vapor bath frequently brings on stupor, he went to a bathing establishment to die in peace. At 127 degrees, Fahrenheit, he found himself cured accidentally. After experimenting, he found prevention easily possible when the treatment was used soon after the bite, and many marvelous cures have since been effected, even when the patients were in the throes of madness. A simple method may be used where access to a vapor bath is not possible. Wrap the patient in a blanket and seat him on an open chair over a pan of water heated by a lamp. It is not known whether it is the sweating that opens the pores, letting the poisons out and thus effecting the cure, or whether the extreme heat kills the germs, or whether both combined produce the result.

By courtesy of the Lawrence Co.
MICROSCOPIC ROOM. HARVEY MEDICAL COLLEGE.

DIPHTHERIA.

Wonderful cures have been made in treating diphtheria by the use of antitoxin. This is a liquid taken from the glands in the neck of a horse which has been inoculated to a fever point with the disease. After the serum is allowed to stand a while the antitoxin comes to the surface and is skimmed off. When the liquid is injected into the patient's blood an immediate cure is effected unless the subject is in the extreme stages. One evil effect from this treatment is a possible weakening of the action of the heart.

APPENDICITIS.

Appendicitis is a disease which is seemingly of recent origin, so much so that it is said to be fashionable to have operations performed for it. The disease is caused by the inflammation of the vermiform appendix, and the old name for it was inflammation of the bowels, from which many people died because of the crude methods then in vogue for treatment. Then the case was not considered one for surgery. The inflammation due to foreign substances in the appendix went so far that it burst the bowels, and the poisons from the abscess were emptied into the abdominal cavity, thus causing death. To-day, upon the least sign of inflammation on the right side of the abdomen, near the hip, an investigation is begun in connection with a small,

worm-like tube attached to the cæcum—one of the intestines. It is less than half a foot long, and is about the diameter of a quill. This organ has no known use, closes by a rather imperfect valve, and, frequently, in adult males and females, becomes inflamed by irritation from fecal secretions, such as result through taking foreign bodies into the system. Fruit seeds, bitten finger nails, buttons and worms will cause inflammation. Great pain accompanies this disease, and any pains, swellings, tenderness, or rigidity of the right abdominal wall may indicate it. The surgical operation for appendicitis starts with an incision of several inches in the inflamed quarter. The abscess is probed, sometimes, although not generally. The contents of the abscess are washed out and foreign bodies are looked for. The tissues are washed with antiseptic solutions; then the intestine is drawn out of the cavity and the appendix is removed, after which the intestine is cleansed, sewed up and put back. Then the outer cavity is closed, although sometimes this is impossible at first, and an opening may be necessary for impurities to pass out.

Great advance has been made in skin and bone grafting. Frequently, nowadays, we hear of several persons giving up portions of their skin to be grafted onto people who may have been severely burned. Sometimes a person's own flesh is stripped away from an arm to supply the tissue for a new nose that is to take the place of one lost. In such cases it is often necessary to graft the skin onto the face, and still leave an end attached to the growing arm in order to keep the skin alive. Then after the grafting has set in well the skin may be removed from the arm. Bone grafting is similar. Generally, bones of the ox take the place of silver plates, so common heretofore. These bones are decalcified, or have the lime taken from them by soaking in a weak solution of hydrochloric acid. This renders the bone like so much gristle, and it may be cut up into strips. The cavity that is to be filled with this bone is cleaned,

OPERATING CLINIC, COOK COUNTY HOSPITAL, CHICAGO.

the bone placed in it and the skin of the wound sewed up. Gradually, the bones grow in with the natural bone, become hard, and perform the functions of the human bones perfectly.

SUPRARENALIN, THE LATEST AID TO SURGERY.

The wonderful progress made in recent years in the use of new agencies and appliances by which to facilitate bloodless and painless surgical operations, is signalized anew by a remarkable discovery lately made which promises to become a boon to the world through its potency in mitigating human suffering.

This discovery occurred in connection with the manufacture of bi-products at the Armour & Co. laboratories, where the chemists are now producing a substance called "suprarenalin." It is one of the most precious articles in existence, being worth $7,000 a pound, and is so powerful that one part of it, dissolved in 100,000 parts of water, will show its presence when tested with chloride of iron.

It has been found that the suprarenal gland of an animal—which is found about the kidneys, when reduced to a drug—possesses wonderful astringent properties; so powerful that operations on the eye and nose may be performed without the loss of any blood. With the addition of cocaine such operations are also painless. The great value of this to a surgeon will be appreciated when one realizes that in cutting around the eye he can have a perfectly clear field, and can do his work much more quickly, as a flow of blood would not only obscure the operation, but would make it necessary to stop frequently and wipe it away in order that he may see where he is cutting. The active principle has been isolated at the Armour laboratory, and has been named "suprarenalin," a word that has not yet gotten into the dictionary. It takes 7,000 grains of the fresh granular substance to make one grain of the "suprarenalin." However, it is very powerful, and solutions employed by surgeons in performing minor operations on the eye, ear and throat vary from 1-10,000 to 1-1,000 in strength.

"Suprarenalin" is also discovered to be the greatest stimulant known, and is now being used in the place of strychnia and other of the old remedies which were employed hypodermically in cases of heart failure.

ACETYLENE GAS, THE LATEST ARTIFICIAL LIGHT

Acetylene gas is given off when calcium carbide is put into water. Calcium, or calcium carbide, is a hard, porous, grayish material produced by fusing pulverized coke and air-slaked lime in an electrical furnace. One ton of this substance will make 11,000 feet of acetylene gas, which is equal in illuminating power to about 264,000 cubic feet of ordinary city illuminating gas. The method of making the calcium carbide is as follows:

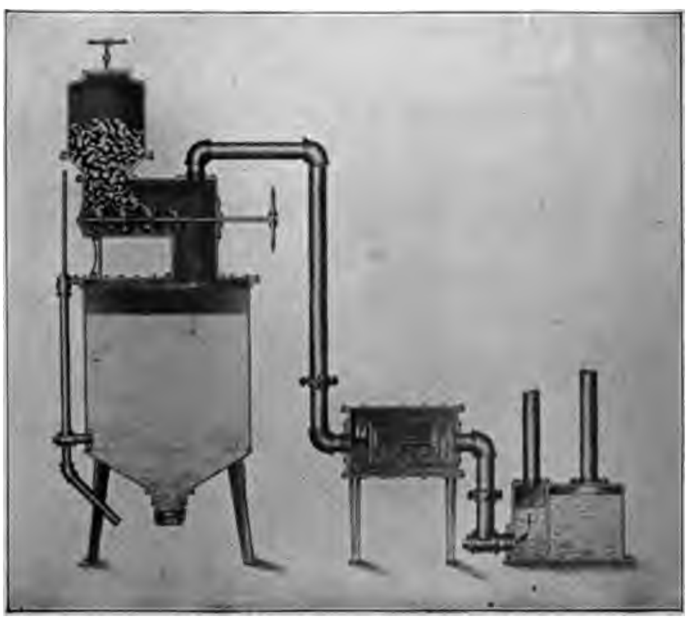
Two thousand pounds of lime and 1,500 pounds of coke are placed in an electrical furnace. The lime is crushed and pulverized by suitable machinery and is slowly air-slaked and then thoroughly mixed with the coke. In the bottom of the electrical furnace is a cast-iron crucible, and the bot-

By courtesy of the Acetylene Apparatus M'f'g Co.
TWENTY-LIGHT GENERATOR. CARBIDE CHARGE, 16 POUNDS.

and lime are fused, producing the calcium carbide.

The calcium remains unchanged in dry air, but if subjected to moisture it gives off a thick heavy gas which smells like garlic. This is acetylene. All that is necessary to do is to control it so that it may issue from a jet in suitable quantities, and then light it. The light given off is of a very brilliant and powerful greenish hue. This gas is highly explosive unless handled carefully. It is being used in great quantities, however, and especially convenient is it on automobiles, carriages, bicycles and for country places where ordinary gas cannot be obtained. The lamp used for vehicles consists simply of a small reservoir, from which water is allowed to trickle upon a quantity of calcium carbide contained in another gas-tight receptacle. From this latter reservoir, leads a small pipe to the gas burner. A match is applied when the gas is generated, which is very quickly,

tom is protected by a thick layer of powdered carbon, which is a good conductor of electricity, but a poor conductor of heat. This bottom plate forms one of the electrodes of the electric cable which conveys the electricity to the furnace. The other electrode of the cable is a large carbon "pencil," attached to the wires that run to an alternating electrical generator. This pencil is let down into the mass in the crucible, and the electricity being turned on, something like an arc light is formed. Intense heat is developed and the coke



By courtesy of the Acetylene Apparatus M'f'g Co.
ACETYLENE GAS GENERATOR, FOR A TOWN.

and for a few cents, a light may be carried for a long time. For more extensive acetylene gas plants, this method is simply enlarged upon.

WONDERFUL MOVING PICTURES

Of recent years, great advances have been made in the art of perfecting magic lanterns. The greatest invention in this line and the one productive of the weirdest results is the device for reproducing, in picture form, the movements of life, so naturally that one would believe the living objects portrayed were passing in review on the lantern screen.

The first step in the discovery of the principle which underlies moving pictures was the invention of the zeotrope. This consisted of a disk, on the back of which were painted a number of pictures of some animal in various stages of motion. Underneath each picture was a narrow slit. The disk was a toy which was intended to be impaled on a pin so that it could be whirled around. By holding the picture side of the zeotrope near a mirror, and by looking through the slits as the disk was spun around, one could see a rapid succession of pictures in the mirror, the animal apparently moving forward by jumps. Inasmuch as the pictures were painted from imaginary positions which were not always true to life, the method of movement sometimes showed very odd phases.

Gradually, the idea of portraying motion grew with inventors, and a principle, in which great development was involved, came to light. That was the method of passing a strip of pictures between the light and the lens of the lantern, and by the use of a light shutter, to close the lens from the light for an instant, between each picture. The most perfect cinematographs, or moving picture machines, now use this method of jerking pictures through a lantern, letting them pause momentarily, and then closing off the light and moving on to the next picture. The result is a continuous picture of the objects in motion, giving the effect of the progression.

When this idea was evolved the next important thing to be discovered was a method for getting exact pictures of things in motion. One man tried the scheme of standing a number of photograph cameras in a row, and taking numerous pictures of the animal, or object, as it moved by. The result was a great improvement, but naturally the cameras could not be placed closely enough together or operated rapidly enough to catch the motions accurately. Then came Edison with his kinetoscope, by which he took instantaneous pictures on long strips of film, at the rate of about 30 photographs in a second. Thenceforth the moving picture problem was comparatively easy.

In this method, long strips of sensitive gelatine films are prepared after the manner of any photographic plate. They are very narrow, are from 70 to 600 feet long, and are wound on spools. These films are run through a photograph camera specially adapted for the work. It is arranged so that only a tiny bit of the film is exposed at the focal point at a time. Then a shutter stops off the light, the film moves on an inch and is exposed, only to be shut off from

the light again, and moved on once more. This is done very rapidly, in fact, so rapidly that about a thousand pictures can be taken in a minute, thus depicting marvelously the actions of moving beings and things.

The next thing to be done was to devise a magic lantern arrangement that would practically duplicate the action of the shutter device on the camera, and also to develop the photographs taken on such long strips, without marring them. Several methods have been adopted for this latter work. Sometimes, the yards and yards of gelatine are wound on windlasses and run through the enveloping chemicals bit by bit. At other times, the strips are wound on pegs and the whole affair immersed at one time. It must be remembered that the pictures taken are negatives,—that is, everything naturally light shows black in the negative, and vice versa. Therefore, pictures must be made that will show on the picture screen in their proper tones. In order to do this, other strips of the sensitive film are placed over the negatives and exposed and developed. When these last strips are dried they are run through the cinematograph machine, but with a very powerful light behind them. The film is unwound and by means of the same shutter device on the camera, the light is turned on and off as the picture is behind the lens or moving into position. The lens throws the picture in enlarged form on the screen placed on the wall. Because of a phenomenon of optics called persistence of vision, the spectator sees the picture for a brief instant after the light is shut off. Thus when the strip is run through, the series of pictures appears as one picture in constantly changing shapes, giving an imitation of life.

LARGEST AND FASTEST TROLLEY CAR

110 MILES AN HOUR.

One frequently reads about trains going at the rate of 100 miles an hour, but few people have ever ridden at a speed of more than 75 or 80 miles. On a little railroad extending from the suburbs of Berlin to the town of Zossen, an electric car travels daily as fast as 110 miles an hour, which breaks all records for speed on the highways of steel.

It is what we call a trolley car, but the trolley system is installed on a very elaborate scale, and the motive power which operates the car is simply enormous. The railroad on which runs this wonderful car is about 16 miles in length, and was built by the Prussian government for military purposes. A few months ago it was turned over to an association of electrical engineers and other experts, for the purpose of ascertaining what speed could be developed by the electric current. Then a car was constructed especially for the purpose, and when equipped with the necessary machinery, weighed nearly one hundred tons. The body of the car is similar to many of those in use on railroads in the United States, with a vestibule at each end, and the roof and sides tapering in order to offer little resistance to the air, when going along at the highest possible speed.

ROAD-BED AND FEED-WIRE SYSTEM FOR HIGH-SPEED ELECTRIC CARS.

The car is divided into three compartments with seats extending transversely, while the motorman is separated from the passengers by a glass partition. What engineers call the three-phase system of electricity is utilized for running the car and the two trailers which it has been hauling during the experiments. Instead of the current being conveyed by one or two wires to the motor, it passes over a series of four, three of which are carried along the side of the railroad upon posts. These are known as high tension, and are capable of supporting a current of no less than 12,000 volts, owing to the system of conduction and insulation. The current passes through the trolley bar, which, as will be noticed, is a very elaborate affair, and thence through transformers to the motor.

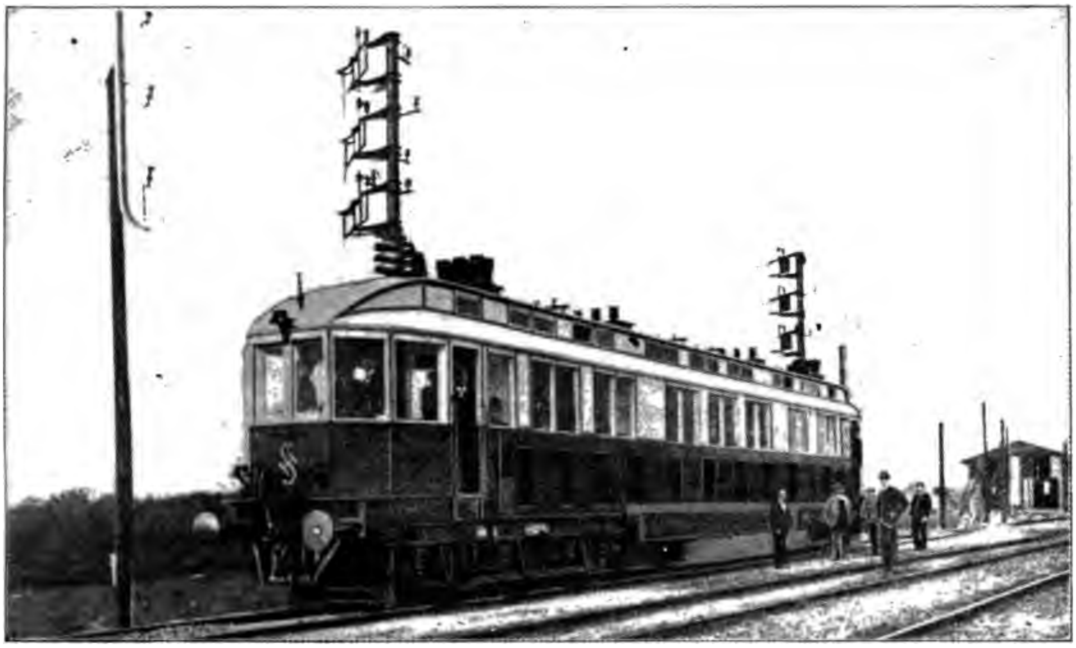
The motors are bolted upon the axles of the trucks beneath the car, each motor being large enough to run an ordinary factory, as it can generate fully 250 horse-power under ordinary conditions. Although these ponderous pieces of machinery weigh no less than four and a half tons each, they move at the rate of 900 revolutions a minute, when a car is at full speed. It would be impossible to stop and start the car with the controller which the motorman uses on the

ordinary trolley system, so special apparatus had to be provided for this purpose. The electric switches and transformers are moved by compressed air, which really does the duty of the motorman.

The inventor of this car claims that within a few years will come a complete revolution of travel on rail, and that electricity with cars of this type will make an average of one hundred miles an hour with as much ease as a speed of 50 miles an hour is now made. Recent experiments with this car have proved conclusively that it can go at a speed of 110 miles an hour without apparent danger, and with absolute freedom from swaying motion.

EDISON'S SWIFT TROLLEY CAR.

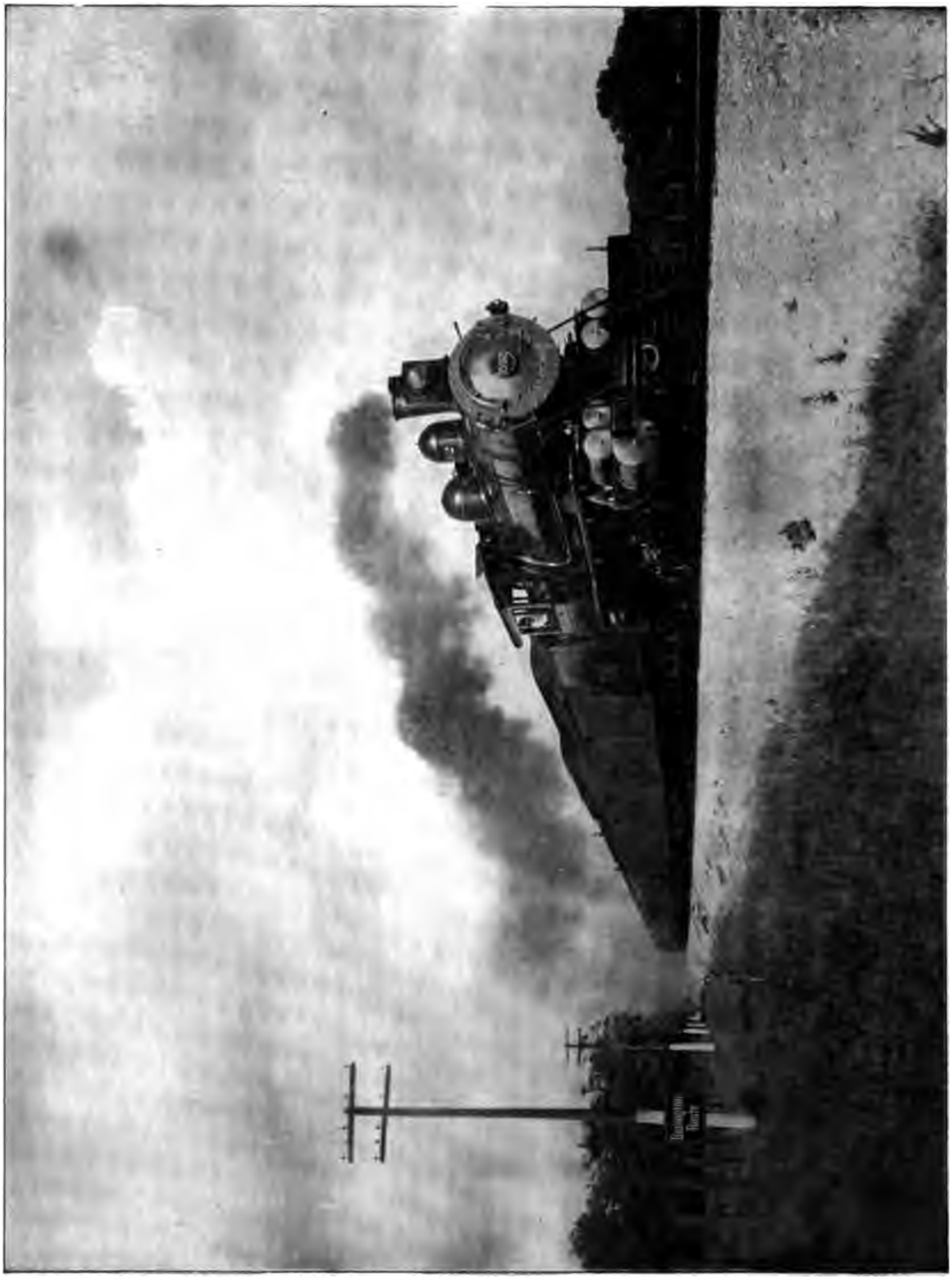
In this country, the genius of Edison has recently resulted in the construction of an improved style of trolley car whose speed closely approximates that of the Prussian invention. Experiments made on a short line in New Jersey, built especially for such a test, indicated that 100 miles an hour could be made with absolute safety and perfect comfort to passengers.



ELECTRIC CAR THAT RUNS 110 MILES PER HOUR.

TRACKLESS TROLLEYS.

Among the novelties in electric propulsion are trolley cars operated in some of the large American and European cities, without the aid of tracks, and large quantities of freight are transported in this manner.



TRANSCONTINENTAL EXPRESS RUNNING SIXTY MILES AN HOUR.

This train took its own picture, by opening the lens of the camera, that had been made ready, as it ran over the connecting mechanism on the track.

BREAD SUPPLIED FROM THE ATMOSPHERE

Back in 1898, the scientific world was alarmed by the statement of Sir William Crookes to the effect that the bread supply of the world was threatened with exhaustion. Sensational as **the remarkable analysis of the situation was, nevertheless, the** statement **remains broadly true that unless** something **develops** to take the place of the **rapidly diminishing supply of** nitrogenous **fertilizers, the world's** wheat **supply is sorely threatened by** the failing **fertility of the soil.** Summed up, **the eminent scientist's** statement was **that the world's** low average of less **than thirteen bushels of** wheat per acre **means literal** starvation for the rapidly **increasing** nations of wheat eaters, **unless** aid comes.

MR. CHARLES S. BRADLEY.

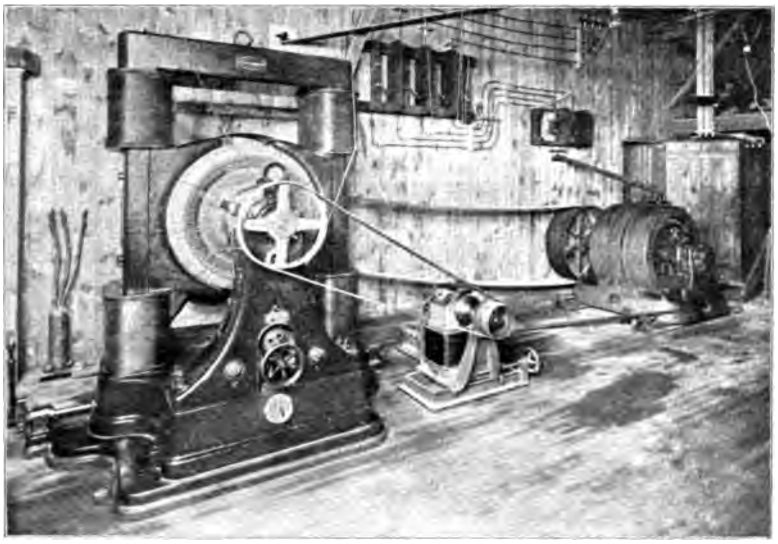
NITRATES ESSENTIAL TO WHEAT GROWTH.

Nitrates supply the fertile qualities of **wheat growth,** but what of the great and **growing** wheat areas that before long must **starve for** soil nutriment? The nitrate deposits of Chile are swiftly being depleted. **The guano** beds of the islands of the Pacific **even now** are cleaned up. The phosphatic beds of the South are strictly limited. Fixed nitrogen in refuse is thrown away with alarming prodigality. Now one hears the prediction that barely 30 years hence it will take 3,200,000,000 bushels of wheat annually to feed the world. This, it is estimated, will necessitate the use of 12,000,000 tons of nitrate of soda a year, over and above the 1,250,000 now used. But the nitrates in sight now promise a supply for only 50 years. The problem thus is serious in the extreme.

MR. D. R. LOVEJOY.

Science, however, is coming to the rescue. Spurred on by the timely warning of Sir William Crookes, scientists all over the world are endeavoring to develop artificial means of producing nitrogen in quantities sufficient not only to supply present needs, but to lay up goodly stores for the future. Be it known that there is nitrogen in superabundance in the very atmosphere we

breathe. On every square yard of the earth's surface nitrogen is pressing in the form of gas in the air, with a weight of seven tons. The question that is perplexing inventors is that of developing a means of "fixing," or extracting it from the air at a little cost. Chilean nitrate costs $37.50 a ton, while commercial nitric acid costs $80 a ton. It is with the ceaseless power of Niagara Falls that enough electricity is derived to extract nitrogen from the air so that nitrate of soda ought to be produced at not more than $25 a ton.



General view of Arc Machine on left driven by Motor at the right, receiving its current from Niagara Power Plant.

Several inventors now have stepped forward in the unique quest for bread from the atmosphere and have erected experimental stations at Niagara Falls. As far back as 1785, Dr. Priestly noted the fact that when a spark of electricity was discharged through the atmosphere the air underwent a chemical change. Any one notices the change in the air after a thunderstorm. The effect of electricity on the air is to enable nitrogen to unite in a chemical combination with oxygen, and thereby become reduced to nitrous acid.

With this knowledge Charles S. Bradley and D. R. Lovejoy have set to work and accomplished much toward the desired goal. After many experiments, they have succeeded at their plant at Niagara Falls in "fixing" nitrogen. The process consists of the production of a large number of electric arcs, or flames, in a confined space, through which a regulated amount of air to be burned is passed from time to time. This air emerges from their apparatus laden with nitric oxides and peroxides, as the result of the combustion, and is ready for collection and treatment.

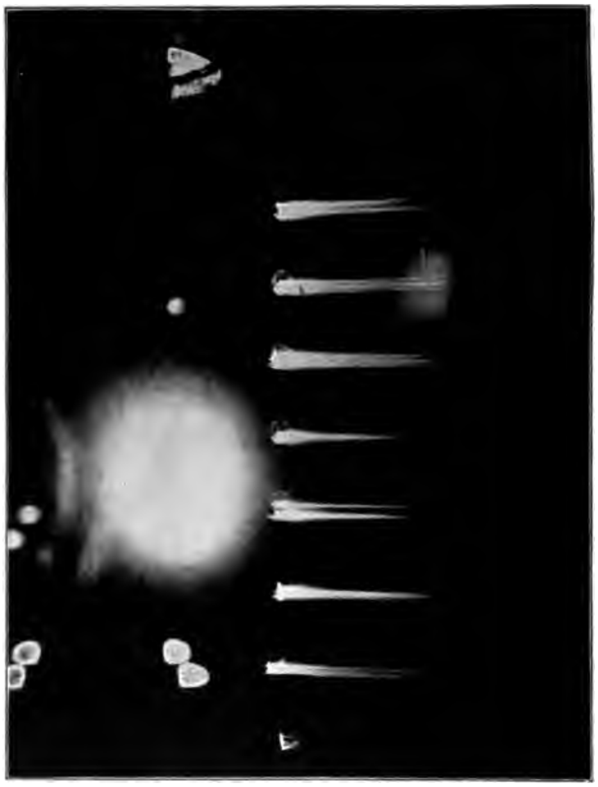
Many difficulties beset the path of the scientists. An extremely long spark was necessary in order to burn the air. It was found that static electricity—obtained from friction on glass — was not powerful enough to supply the arc desired. The great power of Niagara was turned to their use and fair success resulted.

MACHINERY FOR PRODUCING NITROGEN OPERATED BY NIAGARA FALLS WATER-POWER.

The device at last invented consists of a big box of metal six feet high and three feet in diameter. Within this box is a revolving cylinder or hollow shaft. There are openings in the box to admit air and to circulate it, and around its walls are

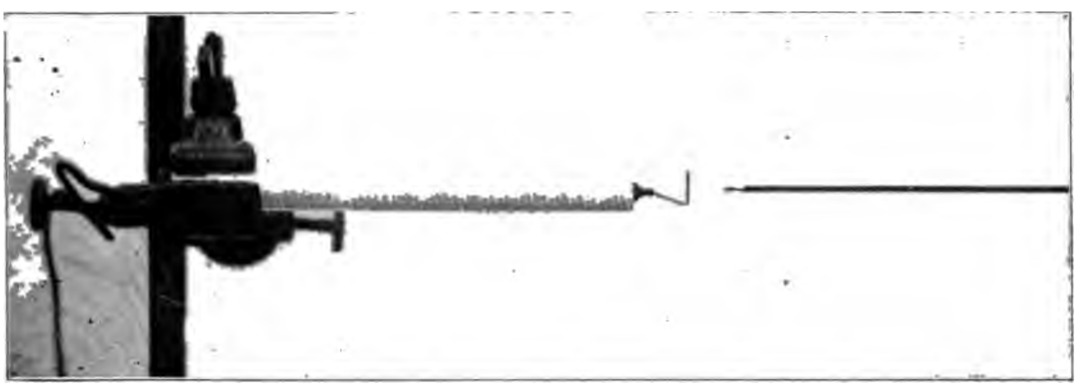
fixed electrical contact points for the arcs, arranged in six rows of 23 points each. The negative pole of a 10,000-volt dynamo circuit is connected with the revolving hollow cylinder, which has contact projections or fingers to touch the other contact points.

The affair is set in motion, whirling at a great rate; the arcs are formed and are broken rapidly, causing a constant stream of electrical fire, and the air is "burned up." A motor at the top of the box drives the cylinder at a speed of 300 to 500 revolutions a minute and air is forced through it at the rate of five cubic feet per arc contact, per hour. The air leaves the treatment loaded with 2½ per cent of oxides of nitrogen. At the bottom of the chamber are pockets to catch the decomposed air and thence pipes lead away which carry the air and its gases to an absorption tower, where the process is completed.



EIGHT-INCH 10,000-VOLT ARCS BURNING THE AIR.

These gases when brought into contact with caustic potash, form saltpeter; with caustic soda, they form nitrate of soda. The effects expected to be obtained will work to fertilize the wheat lands of the world. Already nitrate of soda is being used to strengthen land properties. It has been found from experiments that land bearing 12 bushels of wheat to the acre, by



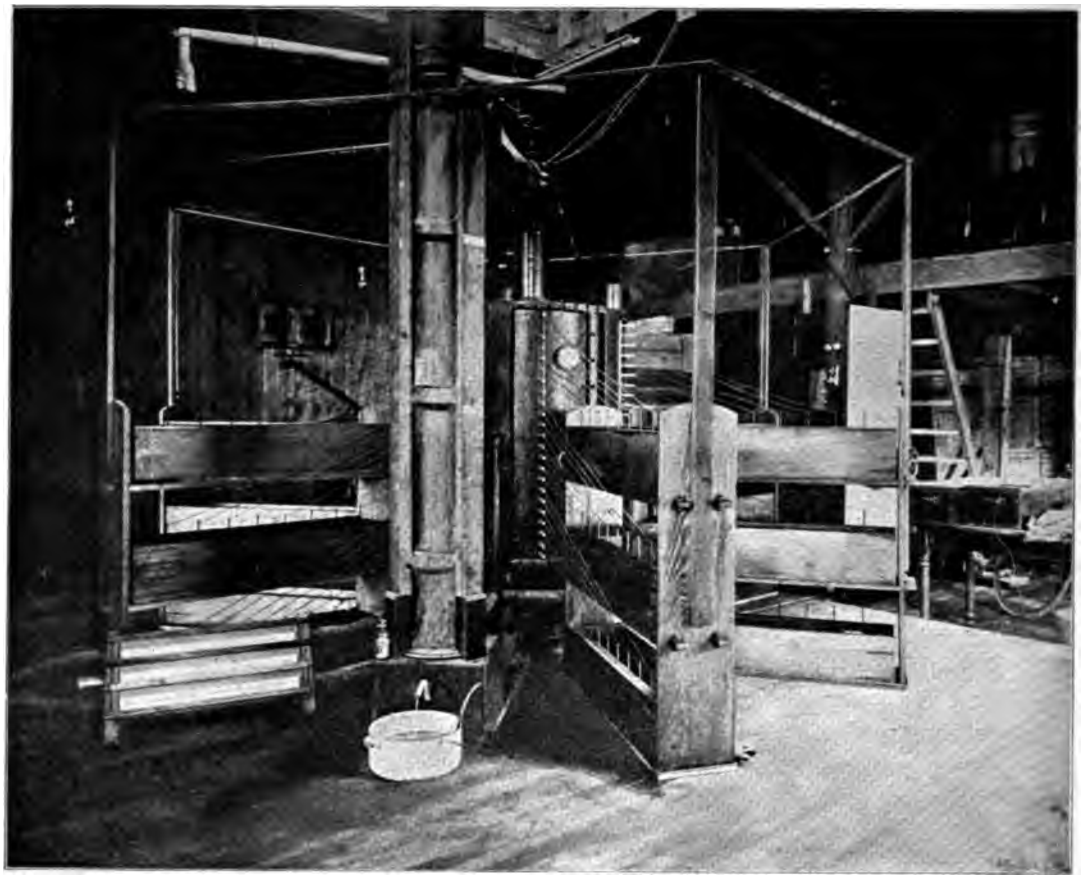
VIEW SHOWING TERMINALS USED FOR ARCING AND BURNING THE AIR IN CHAMBER.

the nitrate of soda treatment, has produced 36 bushels an acre.

SCIENCE WILL GIVE BREAD TO ALL.

If this proportionate increase of production holds good in the course of future experimentations, and there seems to be no reason to doubt that such will be the result, the immense wheat-bearing area of the United States, aside from the stimulated growth in other parts of the world, will furnish adequate material for supplying "the staff of life" to generations untold.

Thus science will be found to have responded once more to the needs of humanity in removing the cause of the grave apprehensions which so seriously impressed the mind of Sir William Crookes.



CHAMBER MOUNTED WITH ARCS.

LIQUID AIR—ITS WONDERFUL POWER

LIQUID AIR BOILING ON A BLOCK OF ICE.

To Charles E. Tripler, a scientist of **New York City, belongs** the credit for having **made liquid** air familiar to the scientific **world, cheapened** its production, and **applied it** to practical commercial purposes.

It seems almost a contradiction in terms at first thought, and yet scientists have been able to liquefy not only air but many other gases, while they can also turn solids into liquid, and the resulting liquid into gases. It is all a matter of temperature and pressure.

Tripler, however, was not the pioneer in experiments. Scientists had long observed that to compress a gas into a reduced volume, raised its temperature greatly. The heat thus resulting was to be generated by the pressure applied, but experiments soon proved it was not caused by the actual increase of the heat of the whole body, but rather by the concentration of the heat of the entire mass into the smaller space.

Later experiments showed that if this gas under pressure was cooled, and then allowed to expand to its former volume, it would fall greatly in temperature, and in practice a drop of 200 degrees was obtained. In 1877, the first real headway was made by scientists in their efforts to liquefy air. The first real success in these experiments was made by Raoul Pictet, who submitted oxygen gas to a great pressure, combined with intense cold, and produced a few drops of the clear liquid that soon evaporated into the air after a few moments of violent bubbling. In 1892, there was a like success with nitrogen, the other constituent of air. About the same time Prof. Dewar, of England, performed the same experiments, and then succeeded in producing a small quantity of liquid air, or rather a sort of slush of air, water and ice. His

PACKING LIQUID AIR FOR SHIPMENT.

LIQUID AIR BOILING BY HEAT OF THE ATMOSPHERE.

experiments aroused the utmost interest among scientists, but the cost of the apparatus and processes, which amounted to $3,000 for this first ounce of liquid air, limited it to laboratory experimentation.

It was Prof. Tripler who discovered the means by which this wonderful product could be made with ease, at a cost of not more than 20 cents a gallon. Tripler's process comes as near being a practical form of the chimerical perpetual motion as can be conceived, as he utilized power generated by the liquid air itself to produce more liquid air, and as the production from a given quantity is in each instance a larger quantity, there is a constant increase of the power at command.

The apparatus for the manufacture of liquid air, in addition to the power plant, is an air compressor, and a barrel-shaped tank about 15 feet high, penetrated by a multitude of small pipes and valves, protected by felt and canvas to keep out the heat. This contrivance is so arranged that the expanding air, which constantly grows cooler, passes about the pipes containing the working material. Air is placed under a pressure of 2,500 pounds to the square inch, and cooled to about 50 degrees by being passed in pipes through running water. From there it is conveyed to the receiver through two different sets of pipe, one containing the air to be liquefied, and the other the air that does the work of liquefying, both under the same heavy pressure. By opening a tap in the receiver, the air from the latter pipe rushes up and around all the pipes in the barrel-like space, expanding, reducing the pressure, taking up the heat wherever any can be found,

DRAWING LIQUID AIR FROM THE LIQUEFIER.

growing warmer, and gradually rising to the top of the space.

While this process is in operation the air in the pipes has been gradually returning to the compresser, where it is again brought under pressure and cooled, only to be released once more in the receiver, there to absorb more heat from the confined air in the pipes. So rapid is this process that the temperature of the air goes down 100 degrees every time it is thus chilled, and it takes only fifteen minutes to produce the desired result. At the expiration of the fifteen minutes the faucet at the bottom may be opened, and the liquid air, at a temperature of 312 degrees below zero, begins to flow from the pipes.

Liquid air is of such an expanding nature that if confined it would explode. In order to preserve the product thus yielded, various devices have been prepared. One of the vessels used for carrying liquid air is a bulb of glass, which is surrounded by an outer vessel, of the same material, the two having a vacuum between them and joined by a common neck at the top. The vacuum thus produced delays the passage of heat, so that the evaporation of the liquid in the inner tube is reduced to a minimum. In a shipment of nine hours, air packed in the above manner, loses less than one-third of its bulk.

Liquid air is eleven and one-half times as powerful as compressed air, and yet it may be carried in a pasteboard box, while the heaviest steel tanks would be required to control as much energy in compressed air. In the meantime Prof. Tripler goes on experimenting with this wonderful air. Inventors of airships are seeking something that combines great power with lightness; submarine navigators want an economical motive power and air for the crews to breathe; deep-sea divers hope that some service may be rendered to their perilous profession by the use of casks of the liquid suited to their apparatus, and automobiles have been adapted to this power. By the use of liquid air, a rose may be frozen in its full form, or an egg may be made so solid that when broken, it will scatter like a powder. The surface of a frozen potato is as hard as stone and beautiful as ivory. Frozen butter may be pounded in a mortar until it is as fine as flour, and raw beefsteak will become pale and then break, like petrified wood. Mercury is frozen, and alcohol

ROSES FROZEN WITH LIQUID AIR RENDERED BRITTLE AS GLASS.

is made stringy and white by this air, and steel bars, when dipped into this liquid, may be burned as readily as a piece of dry wood.

ITS POSSIBLE USE FOR FUEL AND PROPULSION.

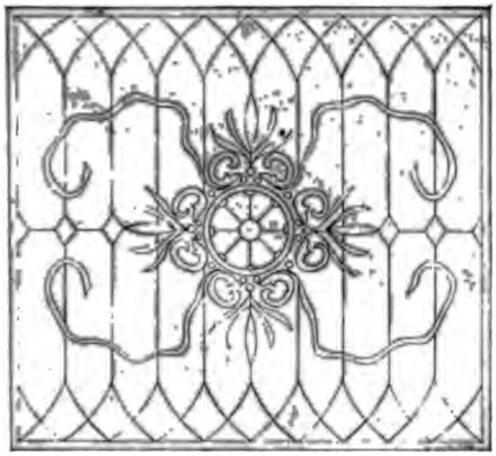
In the not distant future, liquid air may supplant some forms of fuel, for when mixed with any form of carbon, it burns rapidly or explodes. Thus it may be used in interior combustion engines,—for instance, the gas engine.

FULL RECOGNITION OF A GREAT DISCOVERY.

When, with its lightness and extreme potency, it shall be utilized in helping to solve the problem of practical aëronautics, and shall also be made to serve, with a suitable motor, in propelling submarine craft, while at the same time supplying breathing air to the crew, through compression in storage tanks, then, indeed, will be fully recognized the great significance of the discovery of liquid air.

DRIVING A NAIL WITH A HAMMER MADE OF MERCURY FROZEN BY LIQUID AIR.

NEW PROCESS OF MAKING STAINED-GLASS WINDOWS



In a short article of this description, it is possible to give only the bare outlines of the art of making stained-glass windows. To begin at the beginning, when the exact shape and subject of a window is decided upon, a water color sketch is prepared to scale, and then the working drawings and cartoon in full size are made. The drawings are done either in monochrome, charcoal, crayon, pencil, or bister, in wash or in color or pastel, according to the taste of the artist.

The lead glazing lines are usually shown on the drawing, and for the guidance of the glass cutter a tracing of these lines is made on linen. Possibly, the most important, and certainly one of the most delicate functions in the making of a window, now follows—that of choosing the glass itself, for on this depends to a great extent the final artistic results, as will be presently explained. The artist stands by the cutter and chooses each tint, each sheet, and even indicates the particular part of each sheet most suitable for his purpose. For the color is not always even throughout the glass. What to an inexperienced eye looks like a flaw, a splash of different color, or a mass of air bubbles, is produced intentionally in the manufacture of the glass, and eventually adds to the beauty of the window. When the various pieces are chosen, they are cut to shape on the linen tracing. A tracer now marks on the pieces of glass the main lines of the artist's drawing. It is here that one may point out why stress is laid on the importance of the artist choosing his own glass, and not leaving it to the cutter.

A prevalent idea is that a stained glass window is produced by painting white or ordinary glass with various colors, but it

By courtesy of the American Art Glass Co., of Chicago.

is not so. It is in reality a Mosaic of colored glass, shaped by a pigment of one color

By courtesy of the American Art Glass Co., of Chicago.
STAINED GLASS WINDOW—REPRESENTING A HUNTING SCENE.

only, and with the exception of what is called staining, which will be presently explained, the color of the glass is in no way changed. The pigment used is chocolate-brown, in color, and is made of the same earths as the glass itself, with some iron or copper added to give opacity.

The next process is to stick onto a sheet of plate glass, with hot wax, all pieces, placed in their proper order and position and the whole is then covered with a fairly thick pigment, and, while still wet, stippled to let the light through. When the pigment has dried, the lights and half tones are picked out and brushed away, here and there a shadow is strengthened with more pigment, and the work is ready for diapering and staining. The diapers, or patterns, are either painted on in thick opaque lines, or the existing paint is etched out with points, to the required design (see illustration). Staining is painting the back of such portions of glass as may seem desirable with nitrate of silver, which, when sufficiently heated, changes to a brilliant yellow. It can be so manipulated as to give shades from pale lemon to deepest orange.

The pieces of glass are now all dismounted and carefully laid in flat iron trays, the bottom of which contains a layer of white dry powder; the glass is so arranged that no two pieces touch. The trays are then placed in a kiln heated by powerful Bunsen burners, gradually brought to heat and as gradually cooled. The pigment which, as was pointed out, is made of the same earths as the glass on which it is painted, has become, by firing, part and parcel of the glass itself; it is no longer paint, but actual glass.

It is now ready for the glazier who, by means of the design or cartoon, puts the different pieces in their proper places, and joins them together by means of grooved leads, and solder. Around the outside edge of the design, in order to bind the whole firmly together, is fixed a stronger piece of lead than that used to join the pieces of glass.

By courtesy of the American Art Glass Co., of Chicago.
ARTISTIC WINDOW.

Now follows a very dirty process—that of making the window proof against the weather. This is done by rubbing under the leads a cement made of whiting, oil, etc. The whole window on one side is smeared with this, but it is eventually all cleaned off, leaving a deposit under the leads which makes it water tight. Again the glazier takes it in hand and solders onto the lead cross-bars of galvanized iron at proper intervals. It is now ready for setting.

The stone mullions of a window to be fitted with stained glass are grooved on one side deeper than on the other. The glass is slipped into the deeper groove first and then pulled back into the shallow one in the mullion opposite. The iron bars, called tee bars, are set into the stone on each side of the window holding the glass in place. The space between the outer lead of the glass and the stone work is now carefully filled in with cement, to prevent the rain beating through, and then the window is complete.

NEW METHODS OF MAKING PORCELAIN

By courtesy of Taylor, Smith & Taylor, East Liverpool, Ohio.
KILN.

Porcelain ware, according to experts and connoisseurs, is brought to its highest development, artistically and mechanically, in the great imperial porcelain factory near Meissen, Saxony, the oldest in Germany. It was in these immense works that the secret of the Chinese and Japanese "crackleware" was discovered, and now crackleware is made in Saxony as well as in the Orient. The kaolin, or porcelain clay, from which the porcelain paste is made in the Meissen factory, comes partly from underground pits, and partly from open pits in the Saxon villages of Seilitz and Sornzig, and the feldspar comes from Norway.

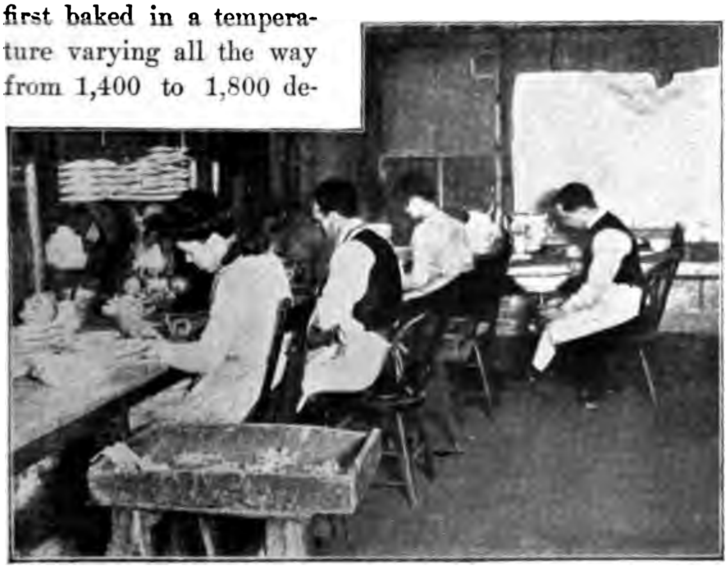
By courtesy of Taylor, Smith & Taylor, East Liverpool, Ohio.
CLAY DEPARTMENT.

The porcelain clay is first washed in a large wooden cylinder, which revolves horizontally, and then is run through a series of vats and channels, into which the heavier substances mixed with the clay are precipitated. The feldspar and quartz are separated from all impurities by means of hammers, and are mixed with the clay. The mixed mass is passed through filter presses and kneading machines, in which the great iron arms and knuckles blend the materials perfectly, and press out all the air bubbles. The mass then is rammed into barrels and stored for a long time, ten months at least, in order to give the clay plasticity and to make it more "workable." In the molding

room, the plastic clay is formed into vases, urns, plaques, statuettes, busts, and other shapes, by modelers, who first make the clay model and then the plaster mold for those pieces which are duplicated and reduplicated, and are finished in plaster molds. Sometimes figures in groups are molded in separate pieces, and then fastened according to the model by means of the thin paste, or "slip," as it is called. The porous plaster of the mold sucks out all the moisture, leaving the molded objects quite dry.

By courtesy of Taylor, Smith & Taylor, East Liverpool, Ohio.
DIPPERS GLAZING WARE.

A "bosser" puts on the finishing touches, correcting all faults in the plastic decorations. Then the articles are ready for the glazing. This is a very delicate and important process and one which requires much care and skill. They are first baked in a temperature varying all the way from 1,400 to 1,800 degrees Fahrenheit, which hardens them, and leaves them porous and very brittle. They then are ready to be painted or finished as white porcelain. In the glazing room each article is carefully dipped into the glaze bath, a milk white fluid, which is composed of kaolin, quartz, feldspar and limestone. As soon as the glazing mixture touches the porcelain all the colors painted on it by the artist disappear, for the glaze forms a powdery crust, which, however, fuses when exposed to a high heat, and the colors reappear. Those parts which are to remain unglazed are carefully covered with a preparation which protects the surface, and the porcelain is put into the kiln. The kilns are circular in form and are built in three stories. The articles in the lowest compartments are exposed to the highest heat, the temperature here reaching 2,912 degrees. The other stories are used to give the first baking.



By courtesy of Taylor, Smith & Taylor, East Liverpool, Ohio.
HAND PAINTING AND GILDING.

By courtesy of Taylor, Smith & Taylor, East Liverpool, Ohio.
PUTTING HANDLES ON CUPS.

SOME LIVE AMERICAN FACTORIES.

Porcelain manufacturing in the United States is rapidly coming to the high standard reached by the foreigners. People have been slow to believe that good ware could be made in their own country, and any but American manufacturers would have been discouraged by this seeming non-appreciation of their fellow-countrymen, but with the vigor and vim characteristic of the race, they have slowly but surely pushed to the front, and their wares are no longer ignored, but conceded to furnish some of the world's best makes. The pottery districts of America are Trenton, N. J., and East Liverpool, Ohio. The latter, including the near surroundings, contains about two-thirds of the potteries of the United States.

Through the courtesy of The Taylor, Smith & Taylor Company of East Liverpool, Ohio, we are able to show some of the departments in their factory which illustrate the method used in making fine dinner

By courtesy of Taylor, Smith & Taylor, East Liverpool, Ohio.
KILN PLACING.

By courtesy of Taylor, Smith & Taylor, East Liverpool, Ohio.
A PRESSER.

and toilet wares. Their model pottery is the envy of all, and every year is visited by manufacturers from all the world to study their modern methods of producing porcelain.

A NEW PROCESS FOR MAKING WHITE LEAD

A new process for the manufacture of white lead has been discovered by a chemist and mining engineer of Boston. This new process is what is known as the "electrolytic," and, judging from recent tests, it will be able to compete with the best now in operation.

In the "electrolytic" process, a solution of sodium nitrate contained in two compartment cells, separated by porous diaphragms, is decomposed by an electric current. The electrodes in these cells are lead and copper. At the positive electrode, lead nitrate is formed and dissolved, and sodium hydroxide collects, and is dissolved at the copper pole. These solutions are drawn off and mixed in the proper proportions, and sodium nitrate is reproduced and lead hydrate precipitated in the form of an amorphous powder. A solution of sodium carbonate is then mixed with the lead hydrate, when lead carbonate (white lead) and hydrate sodium are formed. This sodium hydrate may again be converted into the carbonate by passing carbonic acid into it.

The sodium carbonate may be used again for the conversion of more lead hydrate into white lead. The nitrate reproduced in the second operation may be again used as in the first, and there is but a slight loss in the repeated service of these two agents. During the past year, tests of the electrolytic pigment have been made, and in each instance it has proven itself equal to that manufactured by the Dutch. The new process is rapid, and requires only a small plant for a considerable output. It yields a good paint, with very little labor.

AN OLD INDUSTRY.

The manufacture of white lead, which is the most important of all pigments, is a very old industry, the native carbonate, *cerussie,* having been used by the Romans. But as this mineral is restricted in its distribution, the artificial product was in time brought into use.

THE DUTCH PROCESS.

The so-called Dutch process of making white lead is the oldest known, reference being made to it as far back as 1622. With a few modifications, it is still in use, and yields a product which, for many purposes, is preferred by painters to the lead manufactured by the numerous newer processes. It usually has more covering power, and a better color. The method consists in exposing sheet lead to the direct action of moisture, acetic acid vapors and carbon dioxide. Two other modes of manufacture are generally in vogue—the German, or Chamber process; and the French, or Thenard's process.

MARVELOUS METALS RECENTLY DISCOVERED

RADIUM AND POLONIUM THROW OUT LIGHT THAT SHINES THROUGH IRON. WOMAN SCIENTIST'S ACHIEVEMENT. VALUE OF RADIUM $1,000,000 PER POUND.

A new metallic substance called radium has been discovered by a Polish woman, Madame Sklodowska Curie, who, with her husband, is engaged in scientific work in Paris.

Radium is a white crystalline powder, a combination of several metals, with an illuminating power that far eclipses the Roentgen or X-rays. Its rays travel almost as fast as sunlight and can pierce three feet of iron, burn through metallic cases and take photographs in closed trunks. Professor Curie, the husband of the discoverer, says that he would not venture into a room containing two pounds of radium, as it would probably destroy his eyesight, burn off his skin and even kill him.

Now, before scientists have finished marveling at the new and mysterious metal, the Polish woman has added another to her triumphs in chemistry, by the discovery of a still more wonderful element to which she has patriotically given the name of polonium, in compliment of her native country.

RADIUM'S MIGHTY EXPLOSIVE POWER.

The power of an ounce of radium is sufficient (according to Sir William Crookes) to lift the entire British and French navies from the water.

In a much higher degree than radium it possesses the property of shining in the dark and, like radium, this strange substance does not seem to exhaust itself or lose its luminous powers with the passage of time.

Polonium is extracted from pitchblende, a black mineral found in Bohemia and heretofore considered valueless, after uranium had been extracted from it. Uranium is most commonly used for imparting fine orange tints to glass and porcelain enamel.

As yet too little is understood of the marvelous properties of this new metal to predict just what its uses will be in medicine, surgery and other sciences; but it is not improbable that it may be found to perform the present functions of the Roentgen or X-rays far more powerfully and without their cumbrous apparatus.

VALUE, $1,000,000 PER POUND.

Its vast value, $1,000,000 a pound, must always keep it as a laboratory subject, but one that is pregnant with possibilities to the scientific world.

BUT TWO POUNDS OF RADIUM IN THE WORLD.

The total supply in the world is estimated at two pounds, which, if gathered together, would contain enough potential energy to swing the globe from its orbit. It projects invisible elections—or scientific particles of matter—at the amazing rate of 1,200,000 miles per second. It neither tests nor destroys anything, but a plate of radium one inch square would shine successfully for a million years.

RADIOGRAPH OF A MOUSE.

William J. Hammer, an electrical engineer of New York, has made a series of photographs and radiographs by the light of radium. Among them is a radiograph of a mouse, taken by laying the animal directly on the plate, which was then placed in the bottom of a trunk, wrapped in rugs and allowed to remain there twenty-four hours.

RADIUM'S UTILITIES.

The future uses of radium are likely to be various and important. In connection with the treatment of blindness and cancer, great and beneficent results are confidently expected. The extremely limited supply thus far available restricts its application to industrial purposes; but is understood that a small fraction of an ounce, properly employed, would probably furnish a good light for several rooms, which would last, without renewal, for a hundred years. Calculations have been made indicating that the potential force inherent in one gramme of radium will raise 500 tons to the height of a mile. An ounce would therefore be sufficient to propel a 50-horse-power motor car at the rate of 30 miles an hour around the world.

AN AMAZING TRANSFORMATION.

The most recent discovery in connection with radium, through the experimentations with radium is that a dense vapor is thrown off by it, which is gradually transformed into helium and afterward disappears. This antagonizes a basic idea in chemistry. The gas now found to emanate from it is measurable and weighable and can be bottled, but vanishes within a few weeks. It was at the moment of its disappearance that its spectrum was discovered by Prof. Ramsay to show the peculiar features of helium, which grew more manifest until the identity was established. This astounding transformation suggests the problem whether, if one metal can change into another of a different nature, a similar transmutation, under certain conditions, may not likewise affect many other substances in metallurgy. The latest prediction from scientific sources is that a species of radium will soon be obtainable from petroleum by certain processes now being pursued.

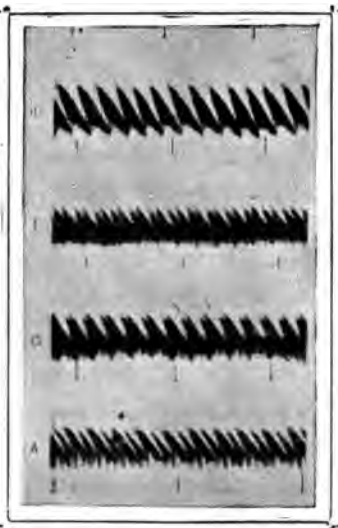
SNAP-SHOTS OF THE HUMAN VOICE

A French scientist, M. Marage, has invented a process by means of which it is now possible to photograph the human voice. The actual vibrations of the air, made in speaking the vowel sounds, can be recorded and made visible by an ingenious use of chronophotography, or the analyzing of motions by means of instantaneous photographs. Every one is familiar with an opposite and synthetic use of chronophotography,—the presenting of animated views of moving objects by means of the kinetoscope.

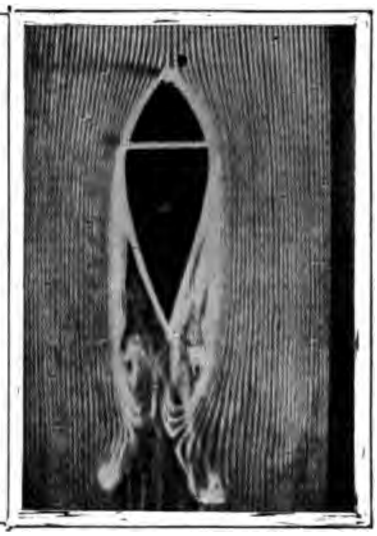
M. Marage's scheme may be described as follows: the vibrations of the air set in motion by the voice are made to act upon the flames of acetylene gas, issuing from specially prepared burners. The flames, vibrating in unison with the sound waves, throw their images into a revolving mirror, which dissociates and causes them to appear in various forms, according to the sound. By means of the acetylene flames, which are photogenic, the vibrations are recorded on a ribbon of sensitized paper.

It has been found possible also to photograph the various functional movements of the body. Thus the motions of the lower jaw in the act of opening the mouth may be represented, as well as the movements of the ribs in respiration. Another ingenious use of chronophotography makes it possible to reproduce in visible form the action of air currents in their passage around an obstruction, as shown in one of the accompanying illustrations.

CHRONOPHOTOGRAPH OF THE MOVEMENTS OF THE JAW.



HOW THE VOICE LOOKS IN FORMING SOME OF THE VOWEL SOUNDS.



PHOTOGRAPH OF AIR CURRENTS PASSING A CURVED OBJECT.

THE SOLAR FURNACE

POWER FROM THE SUN.

A wonderful new invention, running steam engines, smelting all kinds of ores and minerals, heating and lighting houses and cooking all kinds of food, either day or night, by heat of the sun's rays, without fire, fuel or expense, is the Solar Furnace.

STEAM ENGINES.

For running steam engines the sun's rays are concentrated by means of curved reflectors onto a specially built high-pressure boiler, the heat being so intense that the water is turned into steam very fast, two square yards of sunlight furnishing sufficient heat to develop one horse-power, the sunlight falling on a space 44 feet square, furnishing sufficient heat to run a 100 horse-power steam engine. Any engine can be used, but a specially built boiler is necessary. The reflector is mounted on a revolving base and moved by a clock-work attachment that keeps it in focus with the sun all day.

PUMPING PLANTS.

It is thought by some that the solar furnace will revolutionize the present irrigation system, especially in the Southwest, where water is scarce and fuel high. Any amount of water and fuel can be pumped from either deep or shallow wells; no fuel is required, and when a plant is once installed the expense is ended. On all pumping plants requiring over five horse-power, a steam engine is used, the steam being generated by the heat of the sun, as above stated. On plants of five horse-power or less, a "compression" engine with pump attached is used. No fire, fuel, steam, or water is used; nothing but sunlight and air. It is impossible for it to "blow up" or explode. It works automatically, and no engineer is required.

By courtesy of the Solar Furnace and Power Co.

SOLAR FURNACE (SIDE VIEW).

A small plant may be made to pump sufficient water for a large tract by having a reservoir and running the pump every day when the sun shines, using the water only as needed.

SMELTING ORES AND MINERALS.

Any and all kinds of minerals can be smelted, or literally "burned up," if de-

sired. A single yard of sunlight will melt silver, gold, glass or wrought iron to a liquid, while two yards square of sunlight will develop heat of over 25,000 degrees, or more than one hundred times as hot as boiling water.

By courtesy of the Solar Furnace and Power Co.
SOLAR FURNACE (FRONT VIEW).

HOUSEHOLD USE.

A small plant can be installed on the roof of the house at a cost of only a few dollars. Attached to the water hydrant it works automatically and carries steam down through pipes to the kitchen, where it is attached to a steam cooker cooking a dozen different kinds of food at the same time without fire, fuel or expense, and furnishing boiling water for the bath, the laundry and all other purposes.

STORING HEAT AND POWER.

Electric power is generated by a steam engine run by the solar furnace during the daytime and stored up in a storage battery to run machinery, and for heating, lighting, cooking and other purposes nights and cloudy days. The possibilities of the solar furnace are practically unlimited.

A TELEGRAPH MACHINE THAT PRINTS

Along with progress in other electrical devices has come the invention of a practical printing telegraph machine. For years effort has been expended to produce a contrivance that would print automatically from electrical impulses sent over a wire from a distance, but the devices have operated poorly. To be sure, the stock "ticker" serves its purpose in a measure, and when not out of order, is worthy of great commendation. The mechanism, however, is so complicated that the machine cannot be relied upon.

Now comes from Australia a man named Donald Murray, who with great ingenuity, has perfected a device which to-day operates in the offices of the Postal Telegraph Company in many cities, and before long probably will find its way over two continents. Labor saving is not so much the result aimed at and reached in this instrument as the tremendous saving in wire. When it is considered that a single copper wire from New York to Chicago costs $60,000, that it rents for $12,000 a year, and that the Murray system can, on one line, do the business of two or three, the saving may be imagined readily.

This device, the Page-Printing Telegraph, is a series of instruments which automatically receive upon a typewriter telegrams sent over a single wire. There are four main instruments for sending and receiving—two for each station. The send-

ing instruments consist of a transmitting perforator and a modified Wheatstone transmitter. The receiving devices are a receiving perforator and an automatic typewriting attachment.

Upon receiving a message for transmission, the operator sends it through the perforator, which is much like a typewriter. This device punctures a tape with little dots at irregular intervals. The arrangement of these dots signifies certain letters. The perforator writes eighty-four characters. The tape is provided also with a central line of smaller punctures, which engage the teeth of feed-wheels in the machines, thus insuring a steady flow as they are drawn through mechanically. After the message has been perforated on the tape, the tape is fed through the transmitter. This instrument is so arranged that two small rods press against the tape, held in place by small springs. When the rods are even with the perforations they push through for a moment and then are withdrawn automatically. These rods serve to make and break an electrical current. This current is imparted to the wire, traveling as irregular impulses according to the spacing of the perforations.

These impulses pass as signals to the receiving station. The process of receiving the message is similar to that of its transmission, excepting that the latter is done by hand, whereas the former results from electrical energy. To aid in the receiving operation, there is a local electrical circuit. On this line are a punching relay, a governing relay, a vibrator, a receiving perforator and the automatic typewriter. The message arrives on the wire and the impulses are transformed into the local receiving circuit. Automatically, the punching machine perforates the series of irregular dots in the receiving tape. The tape is then fed into the typewriter, which is so arranged that the perforations cause the proper keys to be lifted and the message to be printed in commercial form.

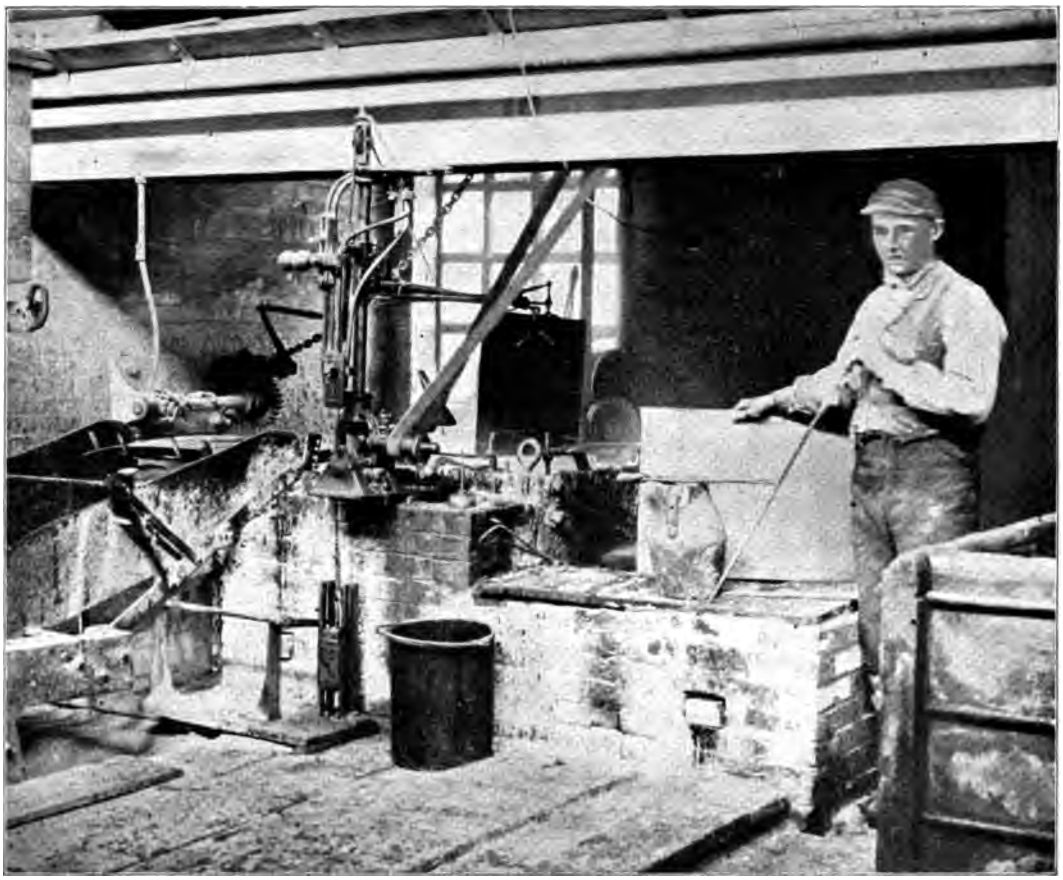
The speed of the system is remarkable. The ordinary Morse system permits of about 25 words a minute. Under similar conditions, the Page-Printing Telegraph transmits and receives about 130 words during the same interval. The perforators can receive messages faster than the typewriting machine can translate them in commercial form, but this is no drawback, as the tape at the receiving station can be torn at certain intervals and fed into several machines at once.

The design of Murray's skilfully contrived apparatus, filed November 28, 1899, in the United States Patent Office, indicates how striking is the contrast between its delicate simplicity of construction and its great importance to telegraphy. Since he perfected the instrument, however, the inventor has made claim for 37 distinct improvements on its various parts, which are now covered by three separate patents. The value of the invention in facilitating the operations of the Postal Telegraph Cable Company, to which the ownership of the patent was assigned, cannot be overestimated.

TIN-MAKING IN THE TWENTIETH CENTURY

Originally the method of tinning plates was the simple expedient of dipping them in a bath of molten tin and allowing the surplus metal to drain off; but about thirty or forty years ago, a Mr. Morewood, of South Wales, Great Britain, designed a tinning machine which has since revolutionized the tinning process. The system consists of placing at the surface of the pot a pair of very carefully turned steel rods, which seize the plate as it comes up and roll off the surplus tin, leaving a smooth and even coating of the metal.

Even this system has been improved, and to-day the rolls are submerged inside the tinning pots in the hot metal and oil baths, and as the plates pass through, while the coating process is going on, it leaves a uniform coating and a highly polished surface. In the manufacture of high-grade



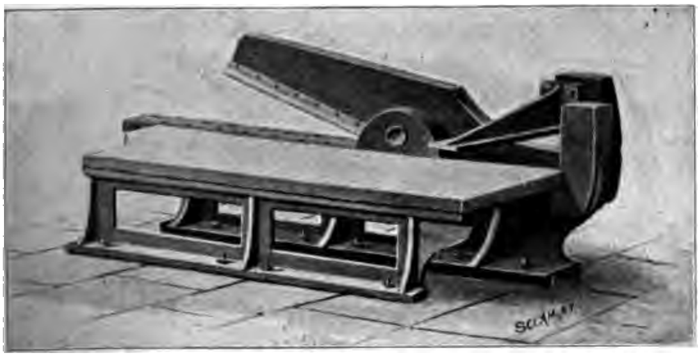
By courtesy of the Scientific American.

TINNING MACHINE.

With Bennett Magnetic Catcher for removing tinned plates as they come from the rolls.

roofing tin, the hand process of dipping is still maintained.

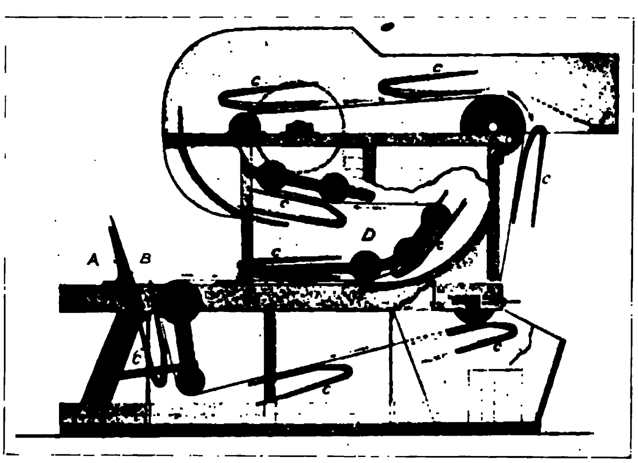
In this hand-dipping process, known as the "MF Style," the plates pass through four or five different pots filled respectively



By courtesy of the Scientific American.
THE CUTTING AND DOUBLING SHEARS.

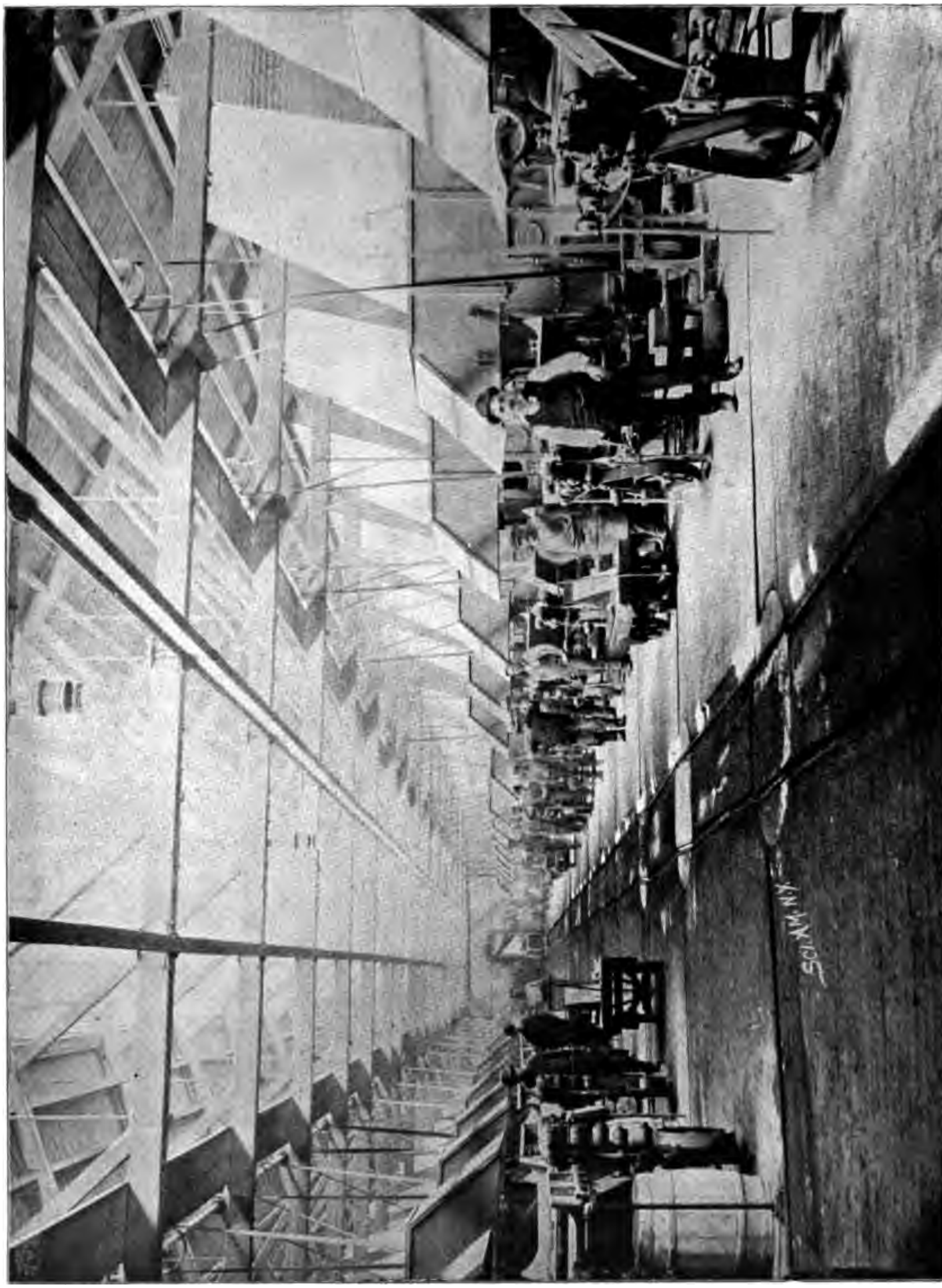
with metal or palm oil. The plates made by this process resist attacks of the atmosphere more thoroughly than plates made in the "coke" tinning process. Recently, a new method of finishing has been introduced. In this method, the plates after coming out of the last old-style of "MF." tinning bath, are immersed immediately in an oily substance, the temperature of which is below the melting point of the coating metal, and an instantaneous and uniform settling of the coating metal is thereby effected on all parts of the sheets alike.

A sectional illustration of a modern tinning machine is herewith given, which shows very clearly its construction. The heavy cast-iron tin pot is carried in a brick setting, and the tin is kept molten by a furnace below the pot. In the bottom of the pot is about 14 inches of the molten tin, and above this on the discharging side are 12 inches of palm oil. The black plate is introduced into the tin pot through the hopper (A). This hopper holds a chemical fluid, the weight of which is less in specific gravity than the molten tin, and which in combination with the tin and iron, causes a galvanic action by which the iron and tin are quickly and thoroughly amalgamated. The tinner pushes the plate downward with a pair of tongs over the curved guide bars until it is seized by the first pair of rolls known as the "feed rolls" marked (B) in the picture. By these it is drawn through the molten tin into the upward curved hopper (C), in which are running two pairs of rolls (D D). The top pair is partly visible and partly immersed



By courtesy of the Scientific American.
THE BRANNER.

in the palm oil which covers the tin on this side of the machine. These rolls are held suspended in a machine frame and are regulated by means of screw-adjusted



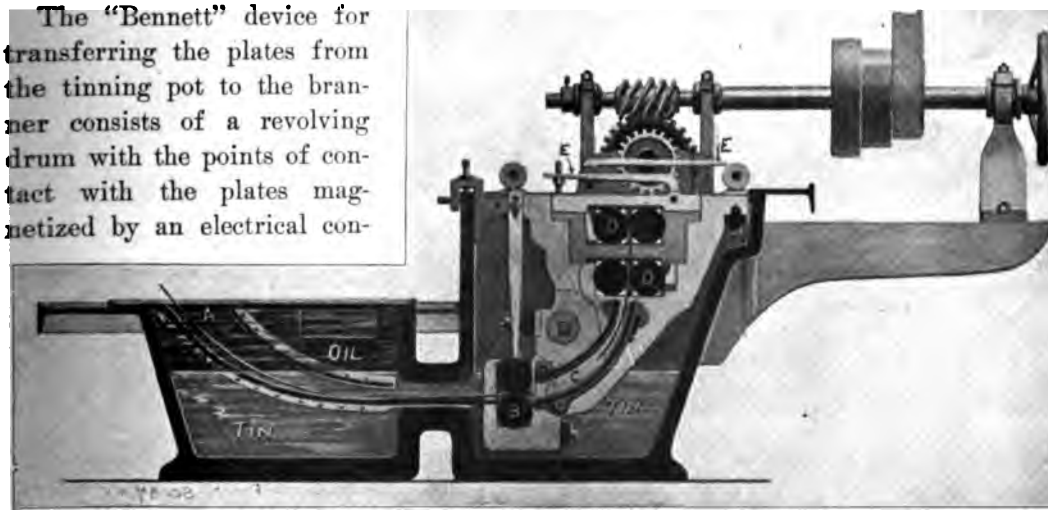
THE TIN HOUSE, WHERE BLOCK PLATES ARE COATED WITH TIN.

By courtesy of the Scientific American.
PLACING BLOCK TIN.

springs (E E). Upon the adjustment de-**pends** the thickness of the coating of tin **given** to the plate.

As the plates come out of the rolls they **are picked** up by a mechanical figure with **arms and** fingers, which stands above the **finishing** pot, taking the place of a man. **It seizes** the plates as they rise through the **rolls, swings** them sidewise, comes to a stop **automatically**, drops the plate into a bran-**ner, and** comes back to its original point of **action,** repeating the operation in rapid **succession.**

The "Bennett" device for transferring the plates from the tinning pot to the branner consists of a revolving drum with the points of contact with the plates magnetized by an electrical connection. As the plates leave the tin pot, they have upon them a thin coating of oil which has to be removed. For this purpose they are put into a branner which is located conveniently at the side of the tinning machine. The branner consists of an inclosed wood and metal box, through which a series of carriers (C) are continually traveling on an endless belt. The plate (B), as it comes from the tinning machine, is placed in a rack (A), which is so located that the plate will be caught up by the traveling racks (C), and by them carried through the machine. The interior of the branner is filled with bran and slack lime and as the carrier travels, it forces the plate through the bran and lime, which cleans off the deposit of palm oil. After the plate has passed through, it drops into what is known as the "duster," where it is passed slowly through a rapidly revolving pair of sheep-covered rollers, which clean off the residue of the palm oil and impart a finish-



By courtesy of the Scientific American.
SECTIONAL VIEW OF TINNING POT.

ing touch or polish to the plate. There are three of these sheepskin rollers and by the time the plate has passed through the set, it shows the beautiful finish for which tin plate is noted.

SUBMARINE NAVIGATION SCORES NEW TRIUMPHS

The day has come when boats instead of floating on top of the water may be so constructed as to dive, swim and stay under the water, almost as long as the operators of them desire. Numerous men have been at work on the idea and many practical results have come from their efforts. Such boats are of prime importance in the war equipments of Governments, and are being studied carefully by experts in the war departments of the nations. In fact many countries have already bought the

THE ASSASSIN OF THE SEA.

Submarine boat "Holland" in action. Possible results shown by practice maneuvers in Narragansett Bay, when the submarine vessel approached close enough to the big cruiser "New York" to blow her out of the water. This was done under the penetrating glare of the fleet's searchlights, which failed to discover the "Holland" until the latter rose to the surface within 75 yards of the supposed enemy.

This vessel proved so successful that six more are nearly completed for the U. S. Government, and England has five in commission.

The "Holland" is 54 feet long, and 10½ feet wide. She contains a 50-horse power gasoline engine, for propulsion; five torpedoes for attack, and requires but nine tons of water ballast to submerge her in three minutes. Her speed is ten knots on the surface, and eight when running under water.

submarine devices and have added them to their navies. They are especially desirable because, when supplied with a number of torpedoes, they can go beneath the water, and destroy whole fleets of the enemy's ships.

THE "GYMNOTE."

There has been considerable advancement along these lines in naval architecture in France. Gustave Zédé has done much, and in 1886, built an experimental boat called the "Gymnote." This was constructed something like a large Whitehead torpedo. It was 56.7 feet long, 5.9 feet in diameter, made of sheet-steel, cigar-shaped, and had a displacement of 30 tons. Driven, when submerged, at a speed of 7 knots an hour by an electrical propeller, and 9 knots above water, this craft proved that much might be done in submarine navigation. Both upright and horizontal rudders were used so that the boat might be steered straight ahead, or made to dive or ascend at will. The batteries would run the device four or five hours constantly. The boat was sunk by means of a heavy ballast attached to the keel of the boat, which was so arranged that it could be detached at a moment's notice. Buoyancy was secured by water-tight compartments, which also supplied compressed air for a crew of five men, when submerged. A long tube ran from the top of the Gymnote, upwards, to the surface of the water. This was equipped with a lens and reflecting mirror. By bending these at right angles a picture of the whole horizon could be seen below. Thus was the boat directed when under water.

So successful were the experiments with this craft that the French government had Zédé work out another boat of greater dimensions. This was named after the inventor, was 147 feet long, 10.75 feet in diameter, had a displacement of 260 tons and, like its predecessor, was cigar-shaped. It could run with a crew of 10 men at the rate of 14 knots on the surface, and 8½ knots below. It was equipped to discharge torpedoes.

THE "HOLLAND."

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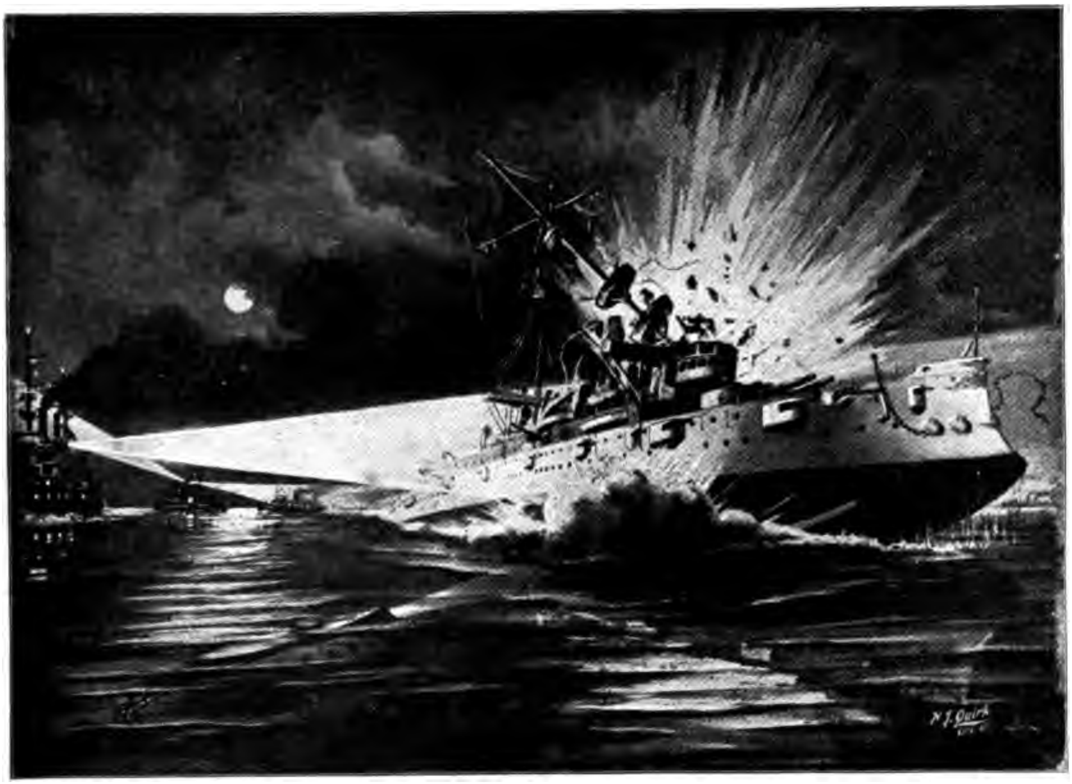
ing touch or polish to the plate. There are three of these sheepskin rollers and by the time the plate has passed through the set, it shows the beautiful finish for which tin plate is noted.

SUBMARINE NAVIGATION SCORES NEW TRIUMPHS

The day has come when boats instead of floating on top of the water may be so constructed as to dive, swim and stay under the water, almost as long as the operators of them desire. Numerous men have been at work on the idea and many practical results have come from their efforts. Such boats are of prime importance in the war equipments of Governments, and are being studied carefully by experts in the war departments of the nations. In fact many countries have already bought the



THE ASSASSIN OF THE SEA.

Submarine boat "Holland" in action. Possible results shown by practice maneuvers in Narragansett Bay, when the submarine vessel approached close enough to the big cruiser "New York" to blow her out of the water. This was done under the penetrating glare of the fleet's searchlights, which failed to discover the "Holland" until the latter rose to the surface within 75 yards of the supposed enemy.

This vessel proved so successful that six more are nearly completed for the U. S. Government, and England has five in commission.

The "Holland" is 54 feet long, and 10½ feet wide. She contains a 50-horse power gasoline engine, for propulsion; five torpedoes for attack, and requires but nine tons of water ballast to submerge her in three minutes. Her speed is ten knots on the surface, and eight when running under water.

submarine devices and have added them to their navies. They are especially desirable because, when supplied with a number of torpedoes, they can go beneath the water, and destroy whole fleets of the enemy's ships.

THE "GYMNOTE."

There has been considerable advancement along these lines in naval architecture in France. Gustave Zédé has done much, and in 1886, built an experimental boat called the "Gymnote." This was constructed something like a large Whitehead torpedo. It was 56.7 feet long, 5.9 feet in diameter, made of sheet-steel, cigar-shaped, and had a displacement of 30 tons. Driven, when submerged, at a speed of 7 knots an hour by an electrical propeller, and 9 knots above water, this craft proved that much might be done in submarine navigation. Both upright and horizontal rudders were used so that the boat might be steered straight ahead, or made to dive or ascend at will. The batteries would run the device four or five hours constantly. The boat was sunk by means of a heavy ballast attached to the keel of the boat, which was so arranged that it could be detached at a moment's notice. Buoyancy was secured by water-tight compartments, which also supplied compressed air for a crew of five men, when submerged. A long tube ran from the top of the Gymnote, upwards, to the surface of the water. This was equipped with a lens and reflecting mirror. By bending these at right angles a picture of the whole horizon could be seen below. Thus was the boat directed when under water.

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vices of the present, was completed, and demonstrated its ability to sub-navigate the sea.

A number of these boats have been built for the United States government at a cost of $175,000 each.

THE "ARGONAUT."

One odd craft for sub-sea work is the "Argonaut," the invention of Simon Lake. It is constructed to float on the surface after the manner of a yacht, dive under water as a submarine navigator, and once under water, to avoid obstacles by being propelled, like an automobile, on wheels along the bed of the ocean or river. This craft is equipped with three wheels, one of which is at the stern and moves so as to steer the boat in it operations. This wheel is also the rudder when the boat is afloat. Only a little weight is necessary to keep the boat on the bottom. Like other vessels of its kind, it has adjustable ballast or weights on its keel. Water is let into the hold to start it downward, and when it is desirable to rise, the weights may be cast off. This vessel is 36 feet long, cigar shaped, with a blunt nose and pointed stern, and is fitted out with a 30-horse-power engine, which is used to drive the screw propeller, driving wheels, the electric dynamo, air compressor and derricks for hoisting wrecks. A steel tube rises like a mast out of the water when the vessel is not entirely submerged, and through this, air is taken in. The ship is equipped with a compass which is found to work well if kept away from the machinery. When the boat is closed up entirely for deep diving, the engines must be stopped for want of air, and then storage batteries operate the machinery. The engines run by gasoline fuel. Air sufficient to supply five men for 24 hours can be carried, and the supply can be increased by running up near the surface and taking in air through the mast tube. This craft is also equipped with a device for leaving the boat when it is under water. A compressed air compartment, with an air lock, is arranged so that by having a strong air pressure in this room, a hole in the bottom of the boat may be opened, and the air pressure being greater than that of the water when it presses to get in, divers can leave the boat and enter again without danger. This manhole is intended for use in leaving the boat to explore wrecks, or in time of war, to pick up and cut cables, and for similar uses. This boat has made successful trips of over 1,000 miles under water.

TORPEDO BOATS BUILT BY THE GOVERNMENT.

The torpedo boats built by the United States Government are capable of steaming a maximum speed of 26 knots. The principal dimensions are,—length, 170 feet; beam, 17 feet; draught, 5 feet 6 inches; and displacement, 180 tons. The engines are triple expansion and twin-screw, and capable of developing 3,200 indicated horse-power, when making 395 revolutions per minute.

The armament of these boats consists of three torpedo tubes, four 1-pounder, quick-firing guns, four 18-inch Whitehead torpedoes, and 600 rounds of 1-pounder ammunition. In speed, tonnage and armament, these craft almost rank with torpedo-boat destroyers.

SAVING SHIPS AND LIFE AT SEA

If one were able to look upon the many wrecks that are strewn upon the bed of the oceans and lakes, he would readily comprehend the value of the numerous devices that find their way to marine bureaus and patent offices, to prevent such maritime disasters. In 23 wrecks, alone, in the last century, nearly 8,000 lives were lost. A map of the Atlantic coast-line of the United States shows places where hundreds of good ships went down with all on board. In the old days when only the hardy mariner traversed the seas, the loss of life was great. To-day, however, when the whole of mankind is inclined toward globe-trotting, and when every precaution is taken to avoid calamity, the destruction of life and property is truly appalling.

Naturally, scientists and inventors have been at work to solve the question of preventing wrecks. The result has been gratifying in the extreme, and one may travel generally with a very reasonable degree of safety. But, with further research, greater improvements in precautionary methods and devices will result.

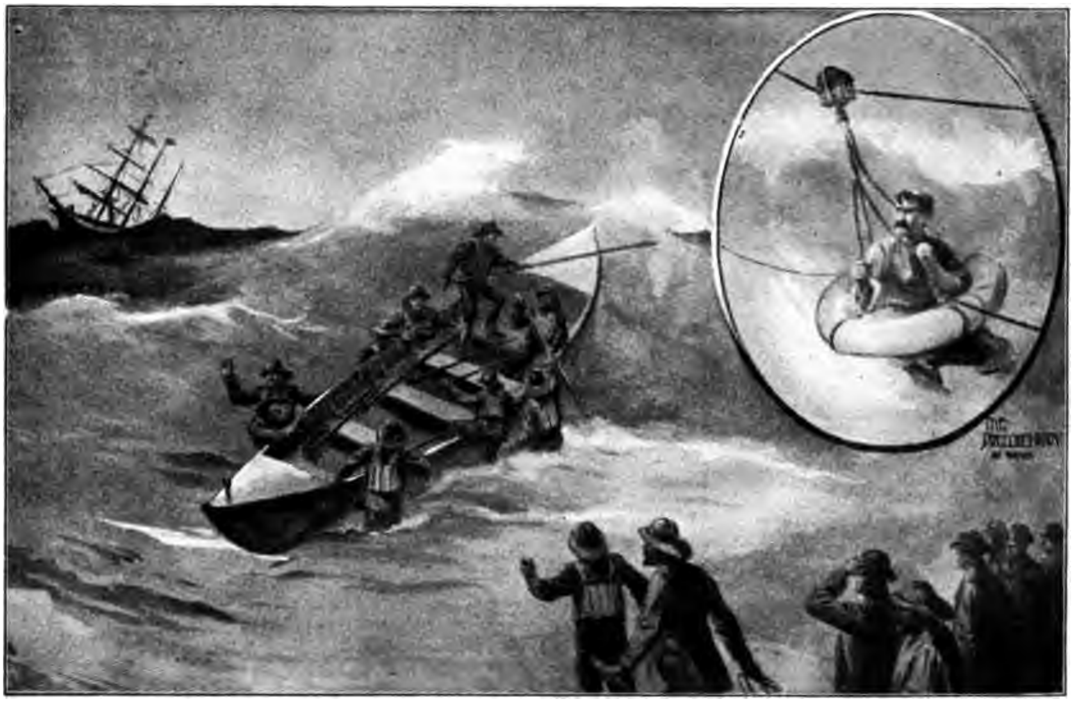
MINOT'S LEDGE LIGHTHOUSE.
The most expensive beacon on the Eastern seaboard,

THE HYDROGRAPHIC OFFICE.

Of prime importance is the protective system of the Hydrographic Office in Washington, and its branches. Here experts study the currents of the oceans, rivers and lakes, plat and chart the spots where danger lies, and advise mariners of their discoveries. In conjunction with the weather bureau, warnings against winds, hurricanes and storms are given. One of the methods applied to rough seas is the old and familiar one, still in vogue, of pouring oil on the water. Many devices have been arranged to do this effectually, and every ship is now equipped with some barrel-shaped machine for letting oil slowly seep out to quiet the angry waves.

THE LIGHTHOUSE.

Each year is adding to the number of lighthouses erected on rocky coasts and reefs. These houses are equipped with the most modern apparatus for warning ships at sea. Great lamps revolve in their high turrets in the lighthouses, aided by powerful prismatic lenses and brilliant reflectors, and sending out their light for many miles. Lightships also are anchored in dangerous places, and send forth their warnings. In many shallow waters, the bell-buoy tolls out its incessant alarm and at night, flares its warning beacon.



THE BREECHES BUOY.
Life-saving expedients on the Eastern seaboard.

Collisions at sea and their accompanying disasters have caused learned men to study how to foretell the approach of dangerous objects. Often, in a fog, an iceberg or another vessel is encountered. The devices invented to prevent this are many. Wireless telegraphy is of great service. Where two vessels are equipped with the Marconi system, it is possible to catch signals many

miles away, and to avoid the same patch in the sea. But this method has not come into general use. Moreover, it would not detect the presence of an iceberg. Consequently a instrument known as the thermopile, or heat detector, has come into use, in various shapes and kinds.

TYPICAL LIGHTHOUSE AND TENDER.

THE ICEBERG.

It is well known that an iceberg greatly chills the water in its vicinity. Similarly, a vessel with great steam-boilers sends out heat. If it is possible to know the temperature of the water in which one's vessel is floating, and to detect some sudden change, either of heat or cold, it is easy to avoid a possible collision. Instruments have been made that are so delicate that they can detect the heat of a candle a quarter of a mile away.

THE THERMOPILE.

The thermopile in use by ship masters is made up of a galvanometer for registering an electric current, and two or more wires of different degrees of sensitiveness when subjected to heat or cold. Some of these different wires are made of copper, German silver, bismuth, antimony or selenium. These metals are arranged to hang over a ship's side in such a manner as to feel a change in the temperature of the water. If an iceberg is near, the chill in the water will be noted, the current sent to the galvanometer, and a bell will be rung. If a steamer is near another bell will ring, de-

noting the approach of a heated object.

Admiral Makaroff, of the Russian navy, has perfected a thermopile which is located in the keel of vessels. It consists of a tube so arranged that the water of the sea may run through it. The thermopile proper is suspended in this water, and if the temperature suddenly changes a danger bell is rung in the pilot house.

Means have been employed to some extent for transmitting warning waves through water. It is well known that water is a great conductor of sound. Divers can easily distinguish the throbbing of a steamer's propeller, or paddle wheels, a mile, or more, away. Work has been done on devices to be placed in the keel of a vessel, consisting of a sensitive diaphragm which will record noises in the water.

TYPICAL RANGE LIGHT.

Another instrument used to detect sound for life-saving purposes, consists of an immense hood connected with a funnel, from which lead rubber tubes, adjusted to the listener's ears. This instrument can be revolved in any direction, and so sensitive is it that distant noises not otherwise audible may be detected. More than this, there is a compass attached to the instrument, and arranged so that it will show the direction of the warning sound.

Possibly the greatest benefit to sailors would be some means for dispersing fogs, and experiments have been made which, ere long, will probably result in such a discovery. Some scientists have been at work on the theory that the moisture in a fog may be condensed by an electrical discharge. To a small degree, this has proved effective. Professor Oliver Lodge, of Liverpool, by means of electrical discharges, cleared a room of thick turpentine smoke, and a reservoir, of magnesium smoke. In announcing his researches before the British Association for the Advancement of Science, he advocated using the donkey engines on board ships, to generate electricity, to be discharged from poles on the masts.

The means of saving life in wrecks are being improved. Each year, new devices are invented, such as automatic davits for letting down lifeboats, etc.

THE LIFE BUOY.

A new life-buoy has been perfected which is so arranged that water is allowed to leak in through a crack and mix with a powder (calcic phosphide). When the buoy is in the water this powder ignites, producing a bright flame which runs out through a tube a foot or so above the water, and, for an hour or so, is visible many miles away. Another sort of buoy has a lighting device and also the means of carrying food and drink.

Besides all these devices for preventing wrecks, there is ever a watchful eye on the lookout to protect the stray mariner from death, after his ship is wrecked. The United States Life Saving Service is a

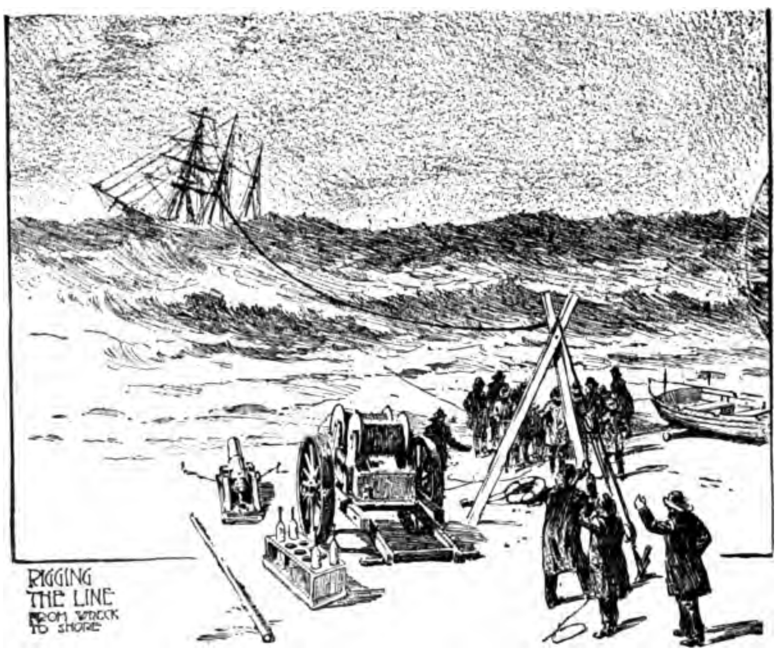
credit to the nation. Its members, like their great brother order of life and property savers, the firemen, accomplish much in the saving of life that would be impossible, were it not for the great hardship these brave men undergo.

Along the coasts of oceans and great lakes, extend lines of life saving stations, manned by hardy crews whose business it is to watch out for vessels in danger, or already wrecked. Patrols of men walk the beaches, or spy out upon the waters from their watch stations, for a sign of distress.

After the distress signal has been sighted, everything in the station is bustle. It may be that a big ship has crashed upon a reef or sand-bar, and is pounding herself to pieces in the angry waves. If the ship cannot be reached from land, the life-savers must clamber into their big boats and pull away to the rescue. Often the savers, themselves, go down before the fury of the tempest, in trying to rescue their fellow men. But, more often, are the sailors, chilled through by the icy waves, brought safe to shore.

THE BREECHES BUOY.

If the use of a life-boat is impracticable, resort may be had to the breeches buoy. The savers are equipped with a coast gun—a sort of short cannon—in which is loaded an iron pin fastened to a life line. The gun is fired off, the pin hurtles over the ship in distress, and the line is hauled in by the weary sailors until a block and tackle are taken on board. This tackle is attached to the mast, a rope is run through it to shore, and down this rope travels a pulley, to which is attached a heavy pair of leather breeches. The sailor gets into this buoy, and is drawn safely through the waves to shore. There are many methods besides these, used by life savers, but these are the most important and most commonly used. Naturally, a life saving station is equipped with the latest kinds of improved boats, etc. The life boat now in most common use is fitted in the bottom with self-acting valves, which empty it of any water that may dash over the sides. So perfect are these boats, that in practice tests, the savers frequently tip them over completely,



Long Island Life Savers Running a Life-line to Stranded Ship.

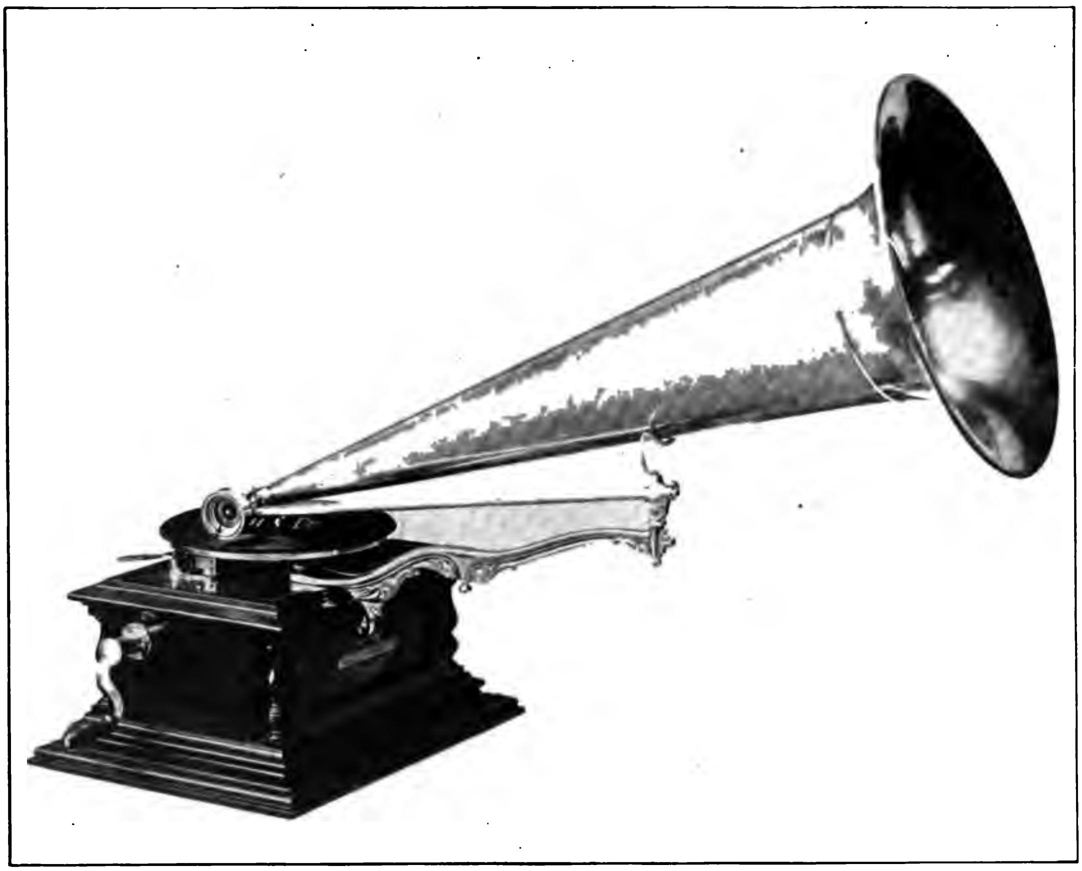
and they will right themselves, and drain off all the water.

THE MINOT'S LEDGE BEACON.

Among the Government lighthouses which serve their beneficent purpose on dangerous coasts, that at Minot's Ledge, Boston Harbor, is perhaps the most noteworthy. It has been twice destroyed, once in 1842 by a drifting ship striking it in a storm, and again in 1863, when a historical hurricane swept the New England coast. The second "house" was supported on steel piles 13 inches in diameter, and after the light went out when the storm was at its worst, the huge beams were found twisted like twine, leaving no other evidence of the tragedy, which cost the lives of three persons living there. The present structure is built of masonry and cement, and promises to last for centuries.

ABOUT THE PHONOGRAPH

Among the many recent inventions which have emanated from the brain of the great wizard of electricity—Thomas A. Edison—is the phonograph. Most people have



By courtesy of James I. Lyons.

THE NEW UNIVERSAL ZONE-O-PHONE, OR TALKING MACHINE.

The highest stage of development yet reached by mechanism in reproducing sound.

seen these clever devices for recording and reproducing sound, but few are aware how the device operates, and fewer still know of its rapidly increasing value in commercial circles.

One must know that sound is a series of vibrations, or waves of the air. When one talks, thousands of waves agitate the ether, the same as water is disturbed when a stone is dropped into it. Edison worked on the principle that these sound-waves were powerful enough to inscribe themselves in records, if given the proper opportunity. After a great many crude experiments, the phonograph was the result.

This instrument consists of a machine upon which revolves a wax cylinder. Elevated over the cylinder and moving along its distance as the machine is set in motion, is a funnel which gathers up the sound waves. At the end of this funnel is a small drum-like affair made of thin metal, upon which is fastened a tiny stylus or pen. When sound is directed into the funnel, it agitates the drum membrane, which in turn moves the stylus very slightly, and this in turn scratches a record of the waves into the wax of the cylinder. Each sound wave has a peculiar motion unlike any other. Therefore when the cylinder has been revolved its entire distance and the pen has scratched the song into the wax, it should be a perfect record of that song only. Such is the case and now it remains to reproduce the sound.

Another drum is attached which has a reproducing stylus similar to the recording one, but of a nature that will not scratch. This pen runs along into all the little scratches made in the record, and agitates the drum membrane in just the reverse manner that it was agitated when the sounds were sent into the funnel at first. Naturally enough this agitation causes the metal drum to give off sounds that very closely imitate those that first went into the phonograph. The motive power to revolve the cylinder is generally developed from a small electric battery attached to it, although clock work will run one for a few minutes.

THE STORY OF THE DISCOVERY.

In 1888, Edison, in commenting on the origin of the phonograph, called attention to the well known effects of certain musical notes and chords, upon sand loosely sprinkled upon a sounding board. He showed how the sand sifts itself into various geometric, curves, differing according to pitch and intensity. He alluded to the fine line of sand left high upon an ocean beach, as each breaker spends its force and then recedes. Continuing, he said: "Yet, well known as these phenomena are, they apparently never suggested until within a few years, that the sound waves set going by the human voice might be so directed as to trace an impression upon some solid substance, with a nicety equal to that of the tide in recording its flow upon the sand beach. * * *

"My own discovery that this could be done came to me almost accidentally, while I was engaged upon a machine intended to repeat Morse characters which were recorded on paper.

"In manipulating this paper, I found that when the indented paper was turned with great swiftness, it gave off a humming noise from the indentations, a musical, rhythmic sound resembling that of human talk heard indistinctly.

"This led me to try fitting a diaphram to the machine."

DRIVING MECHANISM OF THE HORSELESS VEHICLE

Torpedo boats have their machinery stowed away in the most ingenious manner, so as to get the most power concentrated in the least number of cubic feet possible. A watch is a marvelous example of what can be done in the way of packing machinery, but it is doubtful if the torpedo boat or the watch can show such ingenuity in nesting machinery as is shown in the modern steam or gasoline automobile. When the power plant of the steam automobile is exposed to view there is disclosed a complete equipment of engine, boiler, furnace, water tank, pipes, valves, pumps and link motion, with all necessary adjusting devices, and all arranged in space ridiculously disproportionate to the duty required of the engine and the power developed.

There is more machinery in a gasoline automobile, yet it is nested in space very little more than is required to house the steam engine and boiler. A casual glance is enough to impress one who has any love for machinery with the fact that the mechanism is of the highest order. Every member shows the high-class workmanship which entered into its making. Every part bears witness to the skill and ingenious craft of its maker. It represents the aristocracy of engine building.

By courtesy of the "Motor Age."

LATEST THING IN THE AUTOMOBILE LINE.

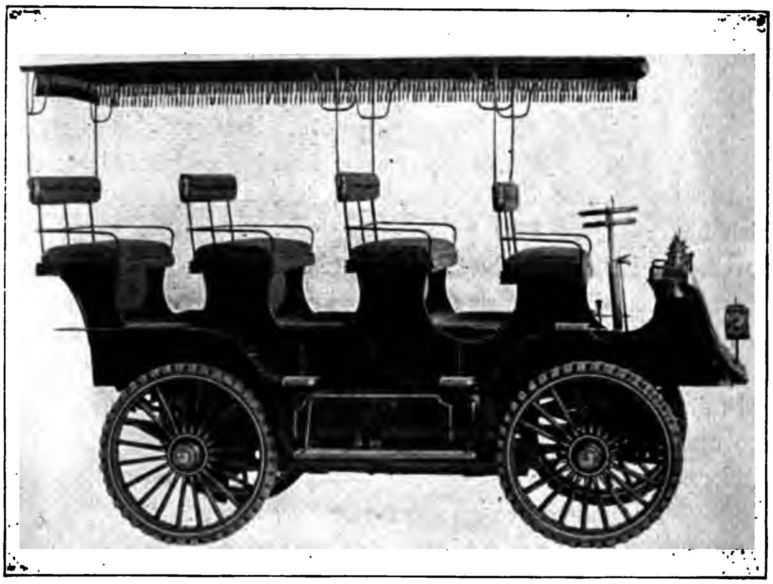
The automobiles that are in daily use are steam, gasoline or electric motor vehicles. There are a few experimental automobiles which use compressed air, but they are not numerous. A large proportion of the natty "runabouts" in Chicago are steam autos, but they use gasoline for fuel. The motor of such a machine is a horizontal engine of the marine type, with plain slide valves, and the link motion which was used by George Stephenson in the first half of the last century. The cylinders of this engine are of cast iron, but the other parts are of drop forgings, and the momentum of the vehicle takes the place of the momentum of a fly wheel.

It was with a steam automobile with an engine of this kind that the world's record for steam automobiles was broken, in October, 1902, by making a mile in one minute and twenty-seven and one-fifth seconds. There was a steam pressure of 650 pounds to the square inch in the wire-wound copper boiler of the machine.

"The cylinders of the engine—there are two of them—are two and a half inches in diameter, the engine has a stroke of three and a half inches and the steam is cut off at five-eighths stroke. The ordinary working steam pressure is 160 pounds. The engine weighs forty-seven pounds and is three and one-half indicated horse power. This is the engine used in the ordinary runabouts which weighs 650 pounds. The boiler is of the fire tube type. It is fourteen inches in diameter and thirteen inches long, and it has 298 copper tubes, each one-half inch in diameter. The copper shell is seamless, with steel heads, and there are about 2,000 feet of steel piano wire wound, in two layers, around the boiler to strengthen the copper shell, which is only three thirty-seconds of an inch thick. The boiler is covered with an asbestos jacket that not only prevents the steel wire from rusting but prevents loss of heat by radiation. The boiler holds about five gallons of water, but carries, when in use, but three gallons.

"The water for the boiler is contained in a tank that holds twenty-seven gallons, and it is forced from this tank to the boiler by a pump attached to the cross-head of the engine. As the pump works all the time while the machine is running, it is necessary to provide means to shut off the water from the boiler when none is needed, and this is done by means of a by-pass and an automatic valve that shunt the water back to the tank when necessary.

"The furnace of the boiler is a Bunsen burner, for gasoline is the fuel. The burner consists of 200 one-half inch copper tubes expanded between two steel plates. The tubes are for the air which is burned with the gasoline. In the steel plates are about fifty small holes for the gasoline vapor, which is taken in between the two plates through a mixing tube from the gasoline jet valve. The heat of the boiler is used to vaporize the gasoline and make it a gas.



By courtesy of Chicago Motor Vehicle Co

TWELVE PASSENGER, BRAKE, CANOPY AND CURTAINS.

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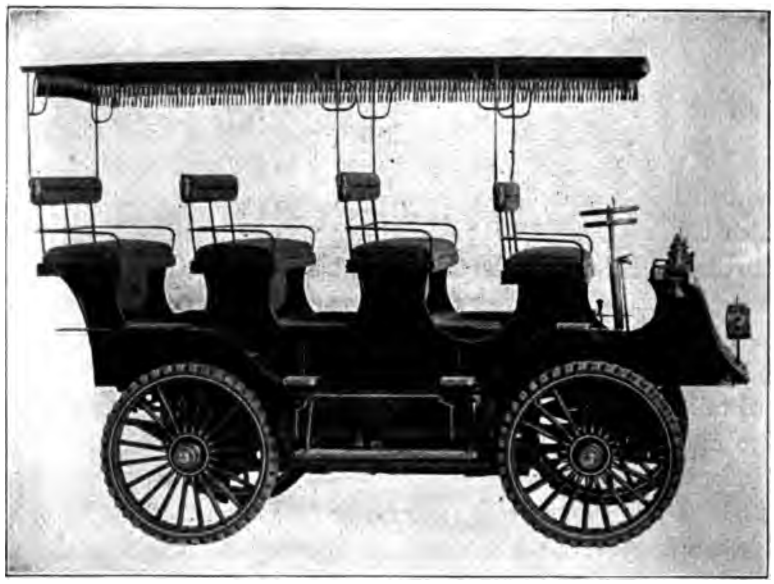


By courtesy of Chicago Motor Vehicle Co

TWELVE PASSENGER, BRAKE, CANOPY AND CURTAINS.

The top plate of the burner is four inches in diameter and the whole burner sits down four inches below the bottom of the boiler.

"The fire is controlled entirely by the steam pressure, which actuates a copper diaphragm whose expansion or contraction opens and closes the needle valve that feeds the gasoline into the burners; the gasoline is under an air pressure of eighty pounds to the inch, so that it jets out in spurts. The diaphragm is normally set for 180 pounds of steam. When the pressure exceeds that amount the diaphragm moves and operates the valve, which reduces the flow of gasoline and thus lowers the flame under the boiler. If the pressure falls below the working standard the diaphragm moves the other way and more gasoline is fed to the fire. The boiler is provided with a safety valve, which blows off at 260 pounds pressure. Between the boiler and the throttle valve of the engine is a globe valve which can be opened and closed only by a key carried by the operator of the automobile. If it is desired to leave the rig the key shuts this lock valve and no steam can enter the engine's cylinders.

"About five gallons of gasoline are carried in the reservoir, and as it takes one gallon to run ten to twelve miles, enough fuel for a sixty-mile run can be carried in the tank. The boiler evaporates about one gallon of water to the mile run. The speed of the machine is controlled by the throttle; the more steam the higher speed. The rear wheels are the drivers, which are driven through differential or compensating gears. This gearing permits the outer wheel to revolve faster than the inside wheel in going around a curve. The engine drives a sprocket which transmits its motion to the differential gearing by means of a steel link belt, and the engine makes two and one-half revolutions to each turn of the gear. When running ten miles an hour the engine makes 300 revolutions. The brake is a double action band brake. Ball bearings are used on the engine as well as on the wheels, and the tires, of course, are pneumatic. The operator has at hand the steering device, throttle valve, reversing lever and brake lever, and in front of him is a steam gauge and air gauge.

"It will be noticed that the steam automobile uses gasoline for fuel and calls in compressed air as an agent to present the fuel to the flame in the best possible manner. In the automobiles operated by gasoline engines, the volatile child of petroleum is the fuel,but it is used without being first burned to raise steam. It is curious that while gasoline is the operating agency of the gasoline motor, water, electricity and compressed air are also necessary. The water is required to keep the cylinder of the gasoline engine cool; the electricity to make the sparks that explode the gasoline at the proper time, and the compressed air to enable the operator to govern the supply of the fluid and gas.

"There is a miniature waterworks system in a gasoline automobile. If it were not for water to cool the cylinder of the engine the piston would stick, and that would end its operation, for the time being at least. The water tank lies up pretty snug to the engine and the water is forced forward through a pipe to the front of the machine, where it passes through the radiator, which might be called the dashboard. It is placed in front so as to get the full effect of the air that rushes through it and cools the water. From the radiator the water passes back and performs its office of

cooling the cylinder of the engine. It then passes on and re-enters the reservoir to continue its cycle of operations.

"The gasoline tank is just above the engine cylinder and holds about five gallons of fluid. There is nothing particularly mysterious in the way the gasoline drives an engine. The fluid passes down a pipe from the tank into a carburetor. This is what you might call a mechanism for vaporizing the gasoline. In the carburetor of this machine there are eight screens, and the gasoline, trickling down, not only is vaporized, but is also mixed with air so as to form a proper mixture. This mixture of gasoline vapor and air is sucked into the cylinder of the engine by the piston. Now this engine here is called a four-cycle engine, which means that the stroke which gives power comes every other revolution.

"Now suppose the engine at rest. The forward movement of the piston sucks in the charge of air and vapor; when the piston goes back on its return stroke it compresses that charge between the piston and cylinder head, and just when the charge is at its highest point of compression an electric spark flashes through it and explodes it. The explosion drives the piston forward, and at the same time the gasoline valve is closed, so that on the fourth stroke—that is, the next stroke backward—the exhaust

By courtesy of the Chicago Motor Vehicle Co.

AUTO TRUCK WITH FROM 2 TO 4 TONS' CAPACITY.

valve opens and the exploded gas leaves the cylinder and goes into the muffler. Then the next forward stroke sucks in a new charge and the same operations are repeated.

"This motor here is what is called an air controlled motor—the air is compressed by a pump in and about the inlet valve which feeds the gasoline to the carburetor and the gas-air mixture to the cylinder. A pipe carries the compressed air forward to the person who is running the automobile. A button controls a valve at the forward end of the pipe in such a way that if it is compressed some of the air is released and the pressure is lowered. And this operates to move the valve so as to allow not only more gasoline to pass into the carburetor, but also more of the gas-air mixture to pass from the carburetor to the cylinder.

"The electric sparks for igniting the charge in the cylinder are made by a little dynamo which is part of the outfit, but in starting the machine, however, the sparks come from an electric battery. When the machine is idle—that is, when the engine is in operation, but the automobile is standing still—the fly-wheel of the engine makes about 100 revolutions per minute. On a good road the motor makes about 800 revolutions, going thirty miles an hour.

The horse power of this engine, which is the style used on the ordinary runabouts, is eight and a half, and the automobile as it stands weighs 1,850 pounds. In its gasoline tanks it carries about nine gallons of the fluid, which on good roads is good for a tour of from 125 to 140 miles. All parts of the engine are automatically oiled, and the mechanism as it stands there is a beautiful example of fine workmanship."

As compared with its competitors, the electric auto is simplicity itself. The driving mechanism is a first-class electric motor; the energy comes from the storage batteries that are carried on the machine. The electric automobile is clean, simple, safe and more expensive than the other styles.

Electricity from the battery passes through a controller, which, by making different combinations of batteries, feeds more or less electricity into the motor, and consequently decreases or increases the speed of the vehicle. For instance, an ordinary electric runabout, at the lowest speed, requires about twenty volts; second speed, forty volts; and third speed, eighty volts; which means that every one of the forty cells of the batteries is at work. An ordinary electric carriage will use from seventeen to thirty amperes per hour.

The average radius of the electric vehicle is forty miles per charge, that is, the average electric auto, with one charging of its storage battery, will travel forty miles without requiring recharging. Some will go much farther—others not so far.

Courtesy of the Woods Motor Vehicle Co., Chicago.

DIFFERENT STYLES OF AUTOMOBILES PASSING IN REVIEW.

INVENTIONS MINIMIZING FARM LABOR

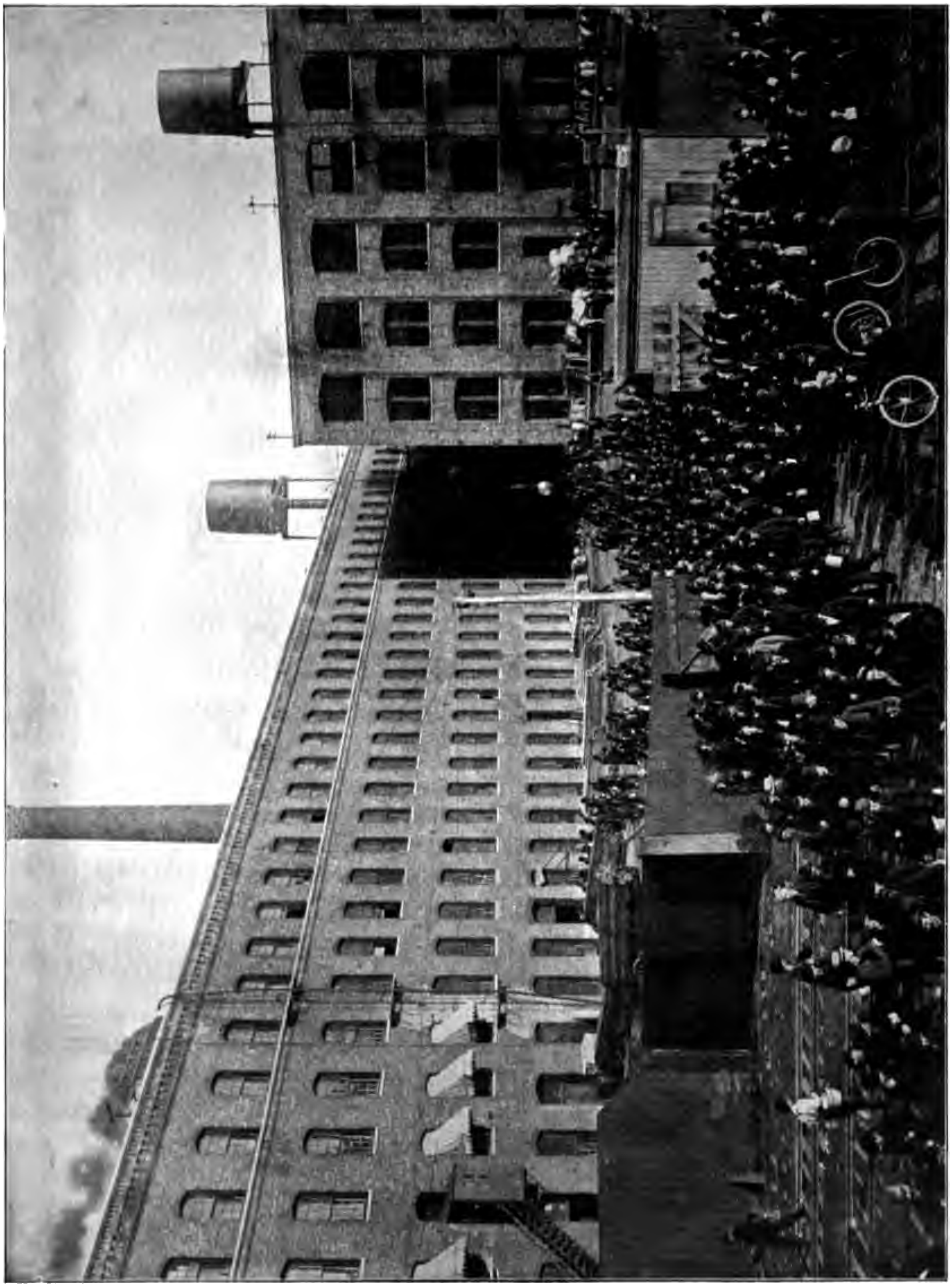
NEW INVENTION DOES TEN MEN'S WORK WITH ONE, AND DOUBLES VALUE OF CROP.

Farm labor, like everything else, has undergone a great change during the last fifty years. Previous to that time, almost everything was done by hand. The sickle, scythe and cradle have been supplanted by inventions that would make the heads of our forefathers reel with amazement.

By courtesy of the McCormick Division, International Harvester Co.
MANUFACTURING BINDER TWINE.

The reaper, a machine designed to harvest small grain such as wheat, oats, barley and rye, was invented in 1831 by Cyrus H. McCormick. Prior to that time wheat and other grains were gathered by hand with the cradle, which had superseded the reaping hook. Since its invention the importance of the reaping machine has been recognized by the world. During the years of the early development of the reaper the Hon. Wm. H. Seward said: "It moved the line of civilization westward thirty miles every year."

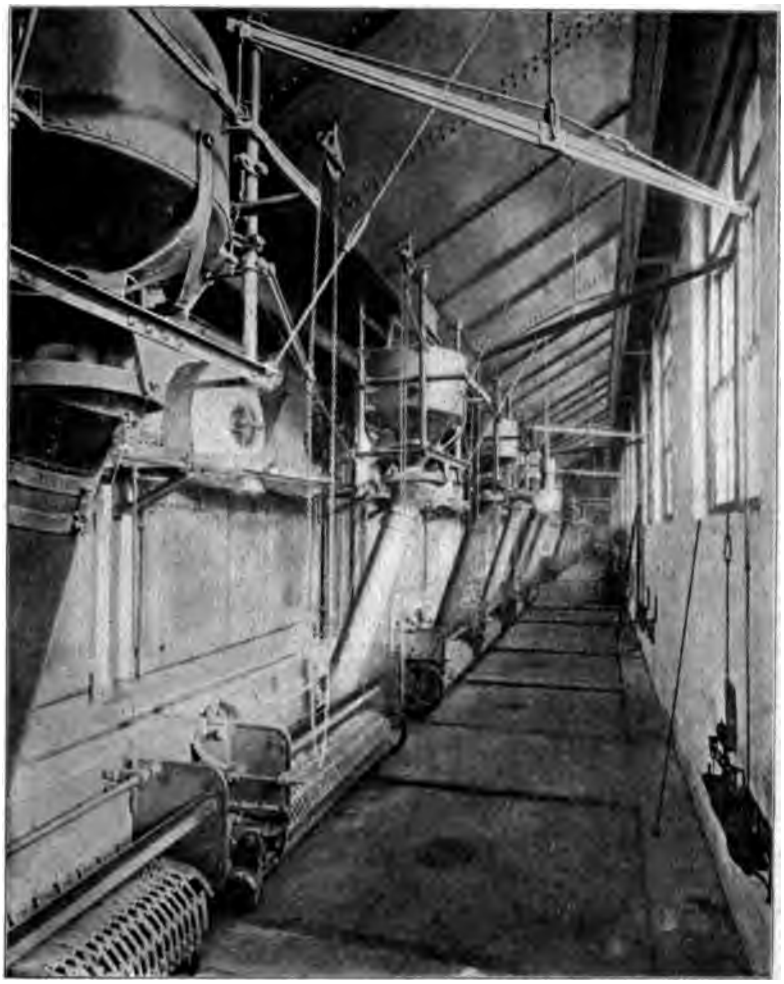
By courtesy of the McCormick Division, International Harvester Co.
BORING KNOTTER FRAMES.



"QUITTING TIME AT McCORMICK'S."

The first reaping machine built by McCormick in 1831, and operated in the harvest of that year, was the prototype of the harvesting machine industry that has grown to the stupendous proportions which characterize it at the present time. To-day more than 3,000,000 McCormick machines are in use throughout the world. Inasmuch as each machine does the work of ten men, the McCormick machines in use are equivalent to an army of 30,000,000 men. These machines have multiplied the world's production of wheat many times, thus banishing the fear of famine, and making flour so abundant that the best bread is no longer a luxury.

Harvesting machines now embrace binders, reapers, headers, header-binders, rice binders, mowers, hay rakes, corn binders and huskers and shredders. The binder, the most improved type of harvesting machine, will cut and bind 15 acres of wheat in a day of ten hours. The machine requires only one man to operate it, while the work it does is equivalent to the work of ten able bodied men. Moreover, the work done by the machine is in every way superior to that done by hand.



AUTOMATIC FEEDING OF COAL IN BOILER ROOM. McCORMICK HARVESTING MACHINE CO.

SHREDDING CORN.

The introduction of the husker and shredder has greatly assisted the farmer in handling the corn crop. The machine husks the corn and shreds the fodder, leaves and husks into feed that is worth as much as timothy hay. By handling the corn crop with machines, the corn grower saves all of his crop—the ears as well as the stalks—thus practically doubling the value of the corn crop, inasmuch as the stalks in former years have gone to waste in the field.

By courtesy of the McCormick Division, International Harvester Co.
SHREDDING CORN.

Chemical analysis has shown that nearly half the feeding value of the corn crop is in the fodder. This makes the hitherto neglected fodder crop the second most valuable one produced in America—worth more than wheat, oats, cotton, hay, or any other crop, excepting the corn itself. The McCormick husker and shredder has made it possible to prepare the fodder at a minimum expense, so that practically the entire stalk is eaten by horses as well as cattle, and do well on it. Some of the statements made by practical dairymen, who have been feeding shredded fodder for years, seem almost incredible. They say that as a milk producer it is far superior to timothy hay, and many maintain that it is better than clover, if fed with a well considered ration of grain to supply the protein, in which fodder is somewhat deficient. Many of the leading dairy and stock men no longer grow hay, plowing up their meadows not needed for pasture and using shredded fodder as their sole forage crop, which enables them to make a large increase in their output of beef and butter.

By courtesy of the McCormick Division, International Harvester Co.
MAKING KNOTTER HOOKS AND BINDER NEEDLES.

THE SEWING MACHINE AND KNITTING MACHINE

SAVING WOMAN'S LABOR AND LESSENING EXPENDITURE.

HOW SEWING IS DONE TO-DAY.

Among the many inventions which have come to the front in the last 50 years is that of the sewing machine. Compare, if you will, the time saved by the use of the modern, up-to-date sewing machine and the work done in the old manner, by hand.

In the sewing machine as in many other inventions America leads the world. Not only is this true of the machine used in the family, but of machines used in manufacturing, for stitching all kinds of textile fabrics and leather, including special machines for buttonholes, eyelets, over-seaming, embroidery, etc.

The idea of sewing by machinery had been cherished for a hundred years before the first successful machine was made. Passing the records made by Thomas Saint, in 1790, and Duncan in 1804, both of England, and those of Dodge (1818) and Lye (1826), both of the United States, because it does not appear that either of their inventions was of practical use, we find that, in 1830, Barthlemy Thimonnier patented a sewing machine in France, which was so successful that, in 1841, 80 of them, made of wood, were in use for sewing army clothes at a shop in Paris.

Several sewing machines, having more or less merit, were constructed in the United States during the first half of the 19th cen-

BEFORE THE TIME OF THE SEWING MACHINE.

tury, the nearest approach to success, prior to 1850, having been made by Walter Hunt, in 1832. No serious attempts were made by him to exploit his invention, nor was it of any benefit until Isaac M. Singer, in 1850, perfected the improvements necessary to make Hunt's product of real utility, and produced the first sewing machine having any practical value. In 1851, Allen B. Wilson took out patents for a sewing machine having a revolving hook for making the double lock-stitch. Other inventors closely followed, and we find that six different manufacturers made about twenty-five hundred machines in 1853. None of these has survived, excepting Singer's and Wilson's. The annual product of the machines developed from these inventions now runs into millions, and they are sent to the remotest parts of the entire world. The most remarkable phase of this development has been the adaptation of sewing machines for special uses in a great variety of manufactures.

In addition to machines of the best type for family sewing, a single manufacturing company makes more than 70 distinct classes, or types, of sewing machines for every stitching process used in manufacture; these classes are fitted with attachments, or devices, for special processes, and there are more than six hundred distinct varieties of Singer machines. There are machines making twelve, or more, seams at once; machines, also, that hemstitch and tuck; machines that ruffle and tuck; machines for stitching books and boots, sewing on buttons and making the buttonholes; in short, the American sewing machine of today stitches everything capable of needle perforation, from lace to leather. This development of special stitching appliances for factory operation has been of tremendous benefit to the world, because it has caused a great reduction in the cost to the consumer of many articles in common use.

Because of this fact, the quantity of sewing done in the home has been greatly reduced, and the finished garment can often be bought for the former cost of the material. Thus, domestic burdens have been correspondingly lessened, and this result may fairly be claimed as due to the inventive genius and executive ability in the field of sewing-machine manufacture.

THE KNITTING MACHINE.

Much of the foregoing comment as to the effect of the sewing machine in lightening the task of the mistress of the household, as well as in lessening the expense incurred for clothing the family, may properly apply to the results attending the introduction of the knitting machine. The enterprise of knitting by machinery has already attained large proportions.

Knitting is a branch of industry which may be termed the twin sister of sewing. The first device ever invented to replace hand work in knitting stockings was the stocking frame, contrived in 1589 by William Lee, of Woodborough, in Nottinghamshire, England. The invention, limited in scope as it was, resulted in making the stocking trade one of the chief industries of the Midlands, for it was the precursor of many ingenious contrivances in this line.

The modern, upright, rotary knitting machine has two cylinders or heads. Each head generally knits four threads at once,

and each thread, or the machinery necessary to knit it, is called a feed. One girl can attend to six cylinders. The needles used are the spring-beard, and they are placed in a mold in pairs, and leaded by having a composition consisting of equal parts of lead and tin poured around them. The gauge is determined by measuring the needles and counting the leads, when set in the cylinder. For instance, 14-gauge has 14 leads, or 28 needles, 3 inches in length, measured on the circumference. A single-cylinder apparatus of 22 inches diameter, 20-gauge, 4 feeds, knitting common hosiery, yarn, cotton and wool mixed, running 45 revolutions, has 920 needles, thus making 165,000 stitches per minute. A 16-inch cylinder, 20-gauge, 4 feeds, cotton yarn, has run 79 revolutions and made 212,532 stitches per minute. Usually, an 18-inch cylinder, 15-inch gauge, is run 45 revolutions; and a table of two heads turns off 160 pounds of knit cloth, per day of 11 hours.

KNITTING MACHINE FACTORY.

Interior View, Showing Up-to-date Methods of Manufacturing Hosiery. This industry has sprung into prominence during the last fifteen years. Our grandmother knitting needle is a weak competition with such an establishment as this.

THE SEMI-AUTOMATIC PIANO PLAYER

The advance of civilization has brought with it a more numerous and critical music-loving public. At the same time, in the press of modern business activity, the man of musical tastes does not often have the opportunity or necessary time for mastering a musical instrument. Again, the beginner's appreciation of the art is often so advanced that his discordant and halting efforts are extremely painful to his sensitive ear.

In fact, he must suppress his loftiest inspirations by a most mechanical system of scales and finger exercises, before he can become even a fair player on such an instrument as the piano. However, necessity is the mother of invention, and the modern semi-automatic players have now come to

READY TO ATTACH THE PIANOLA TO THE PIANO.

the rescue, by affording us all a ready means of playing the most difficult music with our own individual coloring and expression—this too without the necessity of any tedious preliminary practice. Such instruments are well known and already have their accepted place in the musical world.

SINGING WITH THE PIANOLA.

The principles on which wind instruments are automatically played are quite familiar to the general public, but we venture to say that few understand the workings of the semi-automatic piano player, and we therefore take pleasure in acquainting the public with the construction and important features of the Simplex piano player which is also illustrated herewith.

The Simplex piano player is characterized by the simplicity of its construction. One of the accompanying cuts shows the instrument in play-

ing position against the piano, its striker rods being in position over the keyboard, and its pedal lever connected to the loud or open pedal of the piano.

The music rolls used are identically the same as those used on all self-playing organs and the like, because the Simplex is a pneumatically operated instrument. The music roll consists of a long sheet of paper provided with a series of perforations of such dimensions and locations as to co-operate with the mechanism of the player to produce the desired music.

HOW THE PULSE IS MADE TO KEEP A RECORD OF ITS BEATS

Among the modern inventions which have been utilized in connection with the healing art, an instrument called the spygmograph is considered of much value. A skilled physician is often able to detect in the pulse of his patient certain characteristics besides the mere rate, which are highly significant as regards the condition of the circulatory system. The range of these indications has been greatly extended by the spygmograph, an instrument invented by M. M. Chauveau and Marey, by which the pulse is made to write down a graphic representation of its action.

The patient's arm having been placed on a suitable support, a little stud covered with soft leather is lightly pressed against the artery by a spring. The stud is in contact with the shorter end of a very light lever, the other extremity of which is furnished with a point, which registers its movements on a cylinder of blackened metal, made to rotate and advance longitudinally by clockwork; or, the record is taken on strips of flat smoked glass.

As the motion is much magnified by the lever, every variation in the pressure of the blood in the artery during the beat of the pulse is distinctly and faithfully indicated. From the line so traced, the physician may obtain infallible data for judging of the condition of the heart, the action of its valves, etc. It is marvelous to observe the manner in which the curves of this instrument change their form when certain drugs are administered.

The change in some cases occurs immediately, so that the eye can detect by inspection of the spygmographic curve, almost the instant at which the drug was taken into the system, and the nature of its action on the heart.

RESPIRATION REGISTERED IN CHARACTERS BY THE ACTION OF THE LUNGS

An instrument which is doing good service in the hands of medical investigators is the spirograph, in which the rise and fall of the chest in breathing are traced by the motions of a lever, as in the case of the spygmograph. In this instrument a small pad, which presses on the chest, communicates the movements to an elastic membrane, which like the skin of a drumhead, covers one end of a cylindrical box main-

tained in a fixed position relatively to the person of the patient. The air in the box is in communication, by means of a flexible tube, with the interior of a similarly closed box; the elastic membrane of the latter acts against the short end of a lever, which is made to register its movements, the compression of the air caused by the rise of the chest being conveyed to the second box through the flexible tube. The curves furnished by this instrument also give valuable indications, and exhibit marked changes under any influence in the least degree affecting the respiratory system.

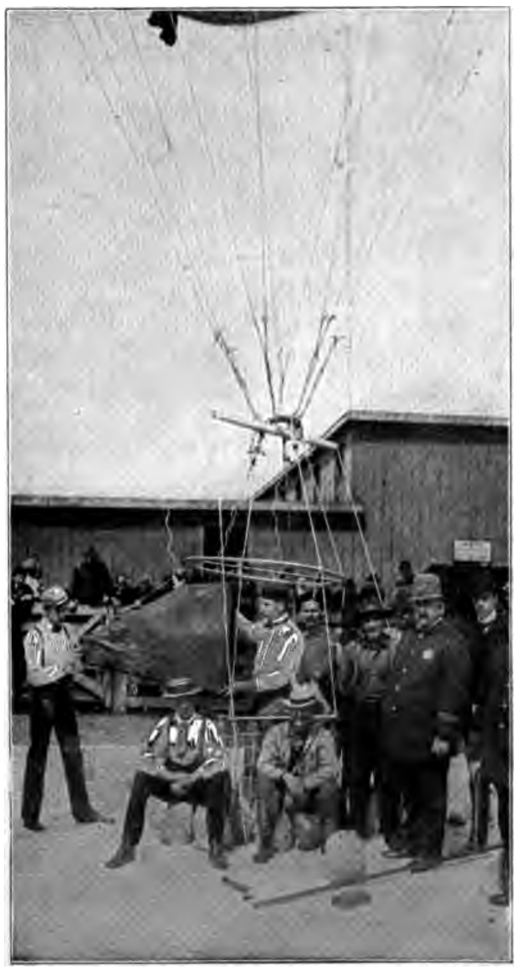
UNIVERSITY OF PENNSYLVANIA.
From which some of the greatest physicians of the age have graduated.

PHOTOGRAPHY AND THE USE OF THE CAMERA

Nearly every person is familiar with the photographer's studio and has had his or her picture taken many times. To most of them the mysteries of the dark room have been explained and many now own snap-shot cameras themselves with which they can take pictures. On the other hand, even those who are amateurs and have taken photographs realize the great strides being made in the science of photography, and what the result of the progress of the art means to the world. It can be imagined readily enough that new kinds of photographic plates are being manufactured which will allow much more rapid exposure of moving objects. The development in the manufacture of sensitive paper upon which photographs are made has also been so great that, nowadays, nature and life are portrayed with remarkable accuracy. Let us look, however, at some of the remarkable things done in the realm of photography.

THE TELEPHOTOGRAPH.

The telephotograph, as its name signifies, is a picture of an object taken from a distance. Most cameras are equipped only to take pictures of objects near at hand. When far off mountains and other inaccessible objects are photographed, usually only small pictures with indistinct details are the result. To-day, however, it is possible to catch pictures as deftly and in as distinct detail as one can view an object from afar through a telescope. The device which permits telephotography is called a rack-and-pinion lens tube in which are fitted two lenses. One of these is the far-seer or negative lens and is the one that does the magnifying, while the other ordinary lens in front of the far-seeing concave lens does the photographing. Work may be done with this combination in the field, all that is necessary being to adjust the rack and pinion to get a good focus. One of the drawbacks to this kind of photography is that because of the smaller range a magnified picture covers, naturally less light is



By courtesy of "Lawrence" Photographer.

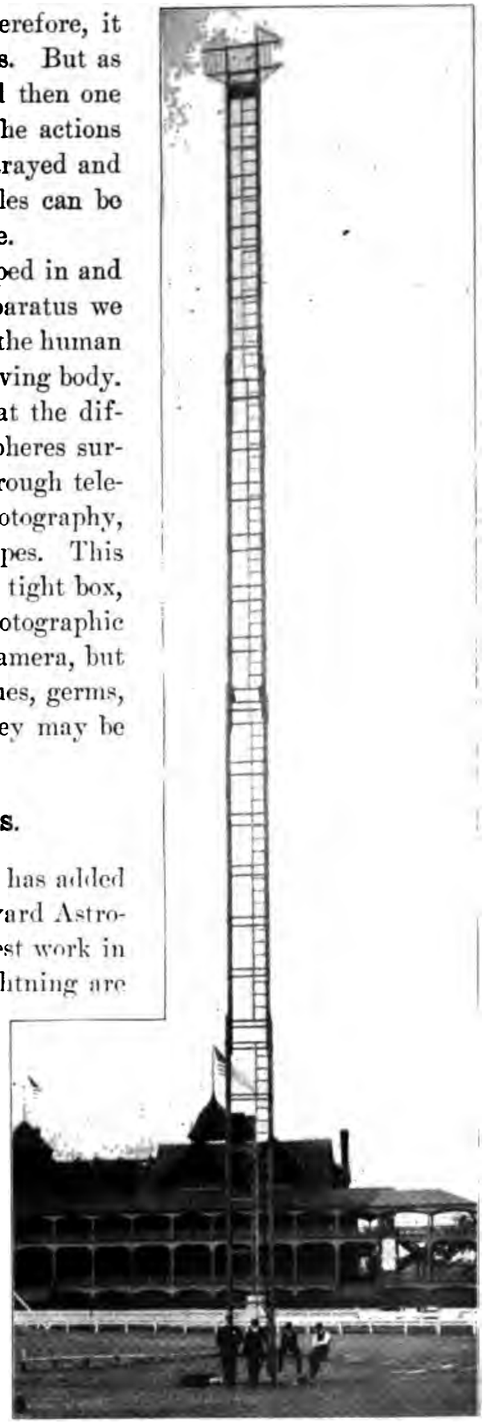
READY TO ASCEND TO MAKE AN ACTUAL BIRD'S-EYE VIEW.

admitted and the exposure has to be longer. Therefore, it seriously retards taking pictures of moving objects. But as time goes on, the apparatus will be perfected and then one may attach it to a cinematograph camera. Then the actions of wild animals miles away can be accurately portrayed and studied. Birds can be caught in flight and battles can be photographed from afar and reproduced in life size.

In delicate scientific work photography has stepped in and done marvelous things. By use of the X-ray apparatus we are enabled to take pictures, or "shadowgraphs," of the human heart, ribs, stomach and other organs through the living body. In astronomy, we have been able to discover what the different stars are made of and what kind of atmospheres surround them. This kind of photography is done through telescopes proper, and is a great deal like micro-photography, which consists in taking pictures through microscopes. This latter method consists simply in attaching a light, tight box, with a very long bellows, to a microscope and photographic lens. This is a good deal like a telephotograph camera, but is used mainly for taking pictures of diseased tissues, germs, and minute animal and vegetable life, so that they may be studied afterwards at leisure.

TAKING PICTURES OF THE HEAVENS.

Taking pictures of lightning, stars, comets, etc., has added much to the knowledge of the world. At the Harvard Astronomical Observatory in Cambridge some of the best work in this line has been done. The photographs of lightning are taken much the same as one takes snap-shots, only the camera is much bigger; in fact, it is a great telescope itself, with a plateholder and sensitive plate attached at the small end—the eye-piece. In taking a picture of a flash of lightning great pains must be taken for one never knows just where to catch the lightning. Besides there is generally rain falling when one wants to take such a picture, and this tends to spoil the scientific value of the picture, because the rain drops act as tiny prisms and break up the light. One of the best experiments in this direction has been in photographing the spectra of stars and lightning.



By courtesy of "Lawrence" Photographer.
PHOTOGRAPHIC TOWER
USED TO MAKE BIRD'S-EYE VIEW.

THE SPECTRUM.

A word about the spectrum. Heat anything to the point where it gives out light, and then pass a ray of this light through a prism of glass and a line of colored bands will result, ranging in some cases all the way from violet through blue, green and yellow, to red. That variegated strip is the spectrum, and the different series of these bands represents the elements in the substance examined. The most familiar spectrum is, of course, that of the sun when its rays are intercepted by the prismatic drops of a passing shower and produce a rainbow. The glass prisms hung as decorations from old-fashioned lamps also make spectra. But a photograph does not produce colors, and lightning will not stay quiet to have its picture taken. How, then, can a spectrum of lightning be photographed? At the big end of the telescope a prism is attached, and by adjusting the camera at an angle, the refraction or turning aside of the rays after they have entered the prism is thrown into the telescope. After a number of pictures have been taken, one or two may be of value. These plates are developed and the lines of the spectrum of the lightning will show. Here comes another difficulty, however, for yellow and red are not colors that can be absorbed readily by the photographic plate. Therefore the pictures of the spectrum will show only different degrees of blackness and whiteness, marked by little waves as the colors affected the plate. But these are still of great value, for, by comparing them with pictures of spectra of known lights, great discoveries have been made.

ELECTROGRAPHS.

Some of the peculiar properties of electricity have been discovered by taking electrographs, or pictures of electric sparks. This is done by interposing a photographic plate, wrapped in a dark envelope, between two poles of a static electrical machine. The spark which jumps from the pole strikes the envelope, penetrates it, and leaps off the plate to the other pole. This exposes the plate and gives a picture. By studying these pictures scientists are enabled to learn much about the laws governing electricity. One already arrived at is that it follows the line of least resist-

By courtesy of "Lawrence" Photographer.
SETTING UP LARGEST CAMERA ON EARTH, PREPARATORY TO MAKING EXPOSURE.

ance, and that often it takes divergent paths in traveling.

USE OF THE CAMERA.

A photograph is not always a picture. The mere regard for the mechanism and chemistry of photography does not insure success in the art, for the results may be a composition far from pleasing to the eye. For instance, a straight front view of the end view of a building is always disagreeable because there can be no perspective.

In photographing anything with height, breadth and depth, all the proportions

should appear. A view from one corner is preferable to any other, although the best effect is seldom obtained by placing the camera directly opposite a corner. The photograph should show, if possible, more of the front than the end. Sometimes, where a street is very narrow, it is impossible to find the ideal position for a camera and in such cases the photographer is obliged to be content with the nearest possible approach to that point. The position of the camera and its height with regard to the object to be photographed are of the utmost importance.

With regard to height, the choicest position is the level of the eyes. When, however, the object to be delineated is so high that the only position of the camera from which the photograph can be taken at the height of the eyes, is so far away that half or nearly half the plate is lost in foreground, it may be preferable to make the exposure from a position nearly half as high as the object. By this means the distance necessary to include the whole figure may be reduced nearly half, and the size of the object in the photograph may be nearly doubled. This is nearly always necessary with tall subjects, when a fixed-focus camera without a rising front or a swing back is employed.

If, however, no place except the ground is available for the camera, the picture will be greatly improved, although considerably reduced in size, by cutting away from two-thirds to three-fourths of the foreground before mounting the print. In no case should the camera be above the center of the height of a building or tower. The picture improves the nearer the camera is brought to the height of the eyes, provided, of course, the whole of the structure is included. Next in importance to the positio of the camera with regard to perspectiv and height, is its relation to light an shadow. A picture in which everythin seen is brightly lighted, is rarely pleasing and one in which the whole view is i shadow is even less attractive. Flatness i a picture is due to want of contrast; tha is, to the absence of high lights in a shado picture, or to that of shadows in one mad from a position directly between the sourc of light and the object. In nearly all sat isfactory photographs, including group and portraits, there is a good blending o light and shade in considerable masses. A photograph mottled all over with shadow and flecks of light in nearly equal propo tions is almost as objectionable as one tha is light, or a shade flat.

The more nearly the masses of shado assume rough triangular forms, the bette the picture; and the larger the triangles so one, either of light or shadow, does no exceed one-half to two-thirds of the are of the plate, the more pleasing the effec This is limited, of course, to buildings an landscapes. In taking a building it is bes to have the front lighted, and the end i shadow. The perspective, of course, if th camera is placed as suggested, makes eac side a triangle more or less regular an complete, according to the style of th architecture.

Light and shadow in a picture are no wholly dependent upon sunshine an shadow. Dark objects serve the same pu pose as shadows. A tree in foliage is al ways dark. A mass of foliage, therefor is as good—often better—in balancing landscape than an actual shady side to som object; and a picture with a high, gree hill or a mass of foliage sloping down fro

By courtesy of "Lawrence," Photographer.

BALLOON USED BY OUR PHOTOGRAPHER IN MAKING PHOTOGRAPHIC BIRD'S-EYE VIEWS FOR THIS WORK.

one corner to a point at or beyond the middle, is always picturesque. Water and sky are nearly always very light, and when they furnish triangles, make the picture complete. On the beach a dark building, a pile of rocks or wreckage, or even a group of people near enough to the camera almost to fill one end of the plate, enhances the beauty of the picture. If a group of people is utilized for the purpose, care should be exercised to have them in dark clothing. White attire defeats the principal purpose of utilizing a group in such a case. The best view of a crowd can be secured from a position overlooking it. A portrait should not be made with the camera very much below the chin of the subject. The level of the middle of the body greatly exaggerates the height of a person. Below is given an illustration of black and white attire.

By courtesy of "Lawrence," Photographer.

ILLUSTRATING THE ART OF PHOTOGRAPHY.

A magnificent and prosperous family: one after the order advocated by President Roosevelt.

BOOK II

WONDERS OF INDUSTRIAL PROGRESS

MANIFESTING PRODIGIOUS STRIDES IN ALL LINES OF HUMAN ENDEAVOR. A CENTURY'S ACCOMPLISHMENT IN A DECADE

THE WORLD'S GREATEST MEAT MART

IT IS a recognized fact that the world's greatest meat mart is located at Chicago. There are other great stock yards and packing houses at Kansas City and Omaha, but they do not begin to compare with the stock yards in Chicago.

The Union Stock Yards are located 4½ miles from the very heart of Chicago. Into these yards run 26 railroads that center in the metropolis of the west. The total area is a trifle over 600 acres, three hundred of which are paved with vitrified brick tiling, which makes the surface most substantial. Running through the pens are 25 miles of streets and alleys, 38 miles of water troughs and 60 miles of feeding troughs. In addition to these there are over a hundred miles of water, sewer and drainage pipes. The total cost of the yards up to the date of this publication is in the neighborhood of $50,000,000.

Courtesy of Armour & Co.
DECOY GOAT LEADING SHEEP.

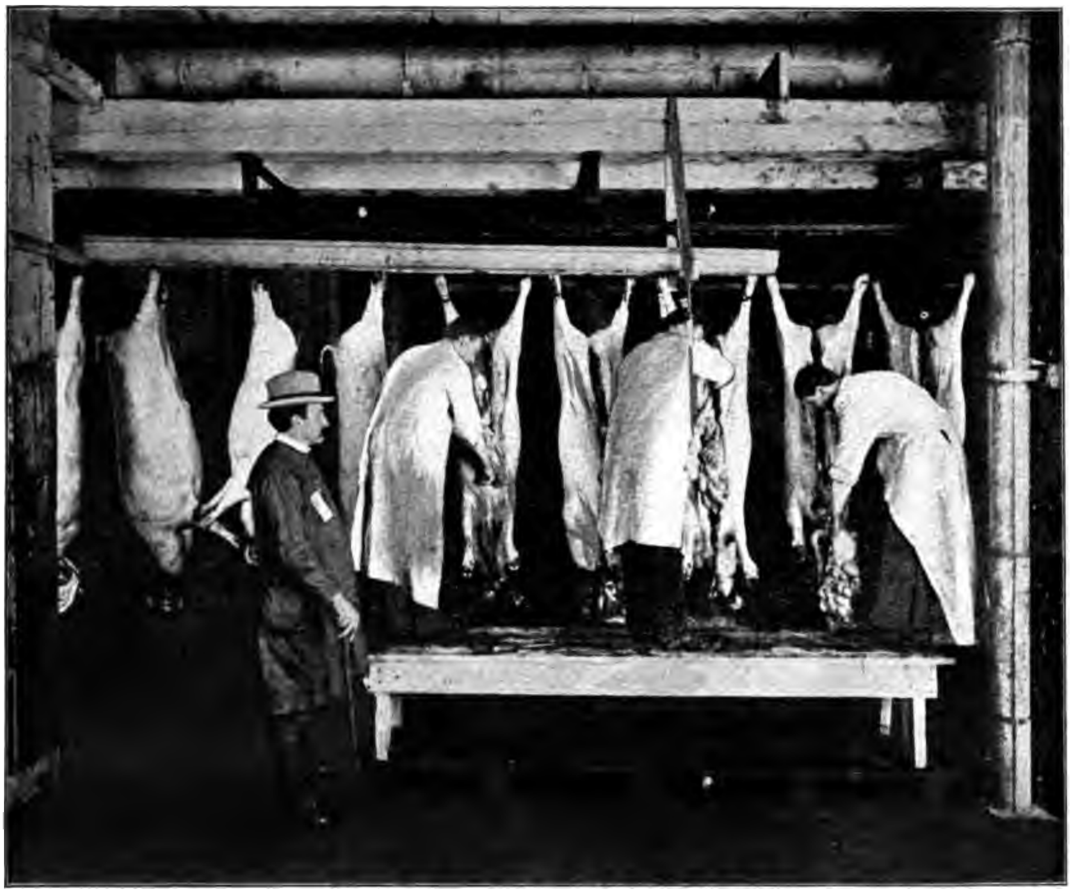
The stock yards were built in 1865, and the first day's receipts of cattle, sheep and hogs numbered a trifle over 300. At the present writing, it is not an uncommon thing to see 20,000 cattle, 30,000 sheep and 45,000 hogs in the yards at one time. The annual receipts of live stock are approximately as follows: 2,900,000 cattle, 155,000 calves, 9,325,000 hogs, 3,600,000 sheep, and about 130,000 horses and 10,000 mules. To bring this stock into market requires nearly 400,000 cars, which would make a train almost long enough to reach across the continent, from New York to San Francisco. In the yards there are about 15,000

pens, of which 8,000 are roofed in for sheep and 3,000 pens, or "double decks," for hogs.

200 MILES OF RAILROAD TRACKS.

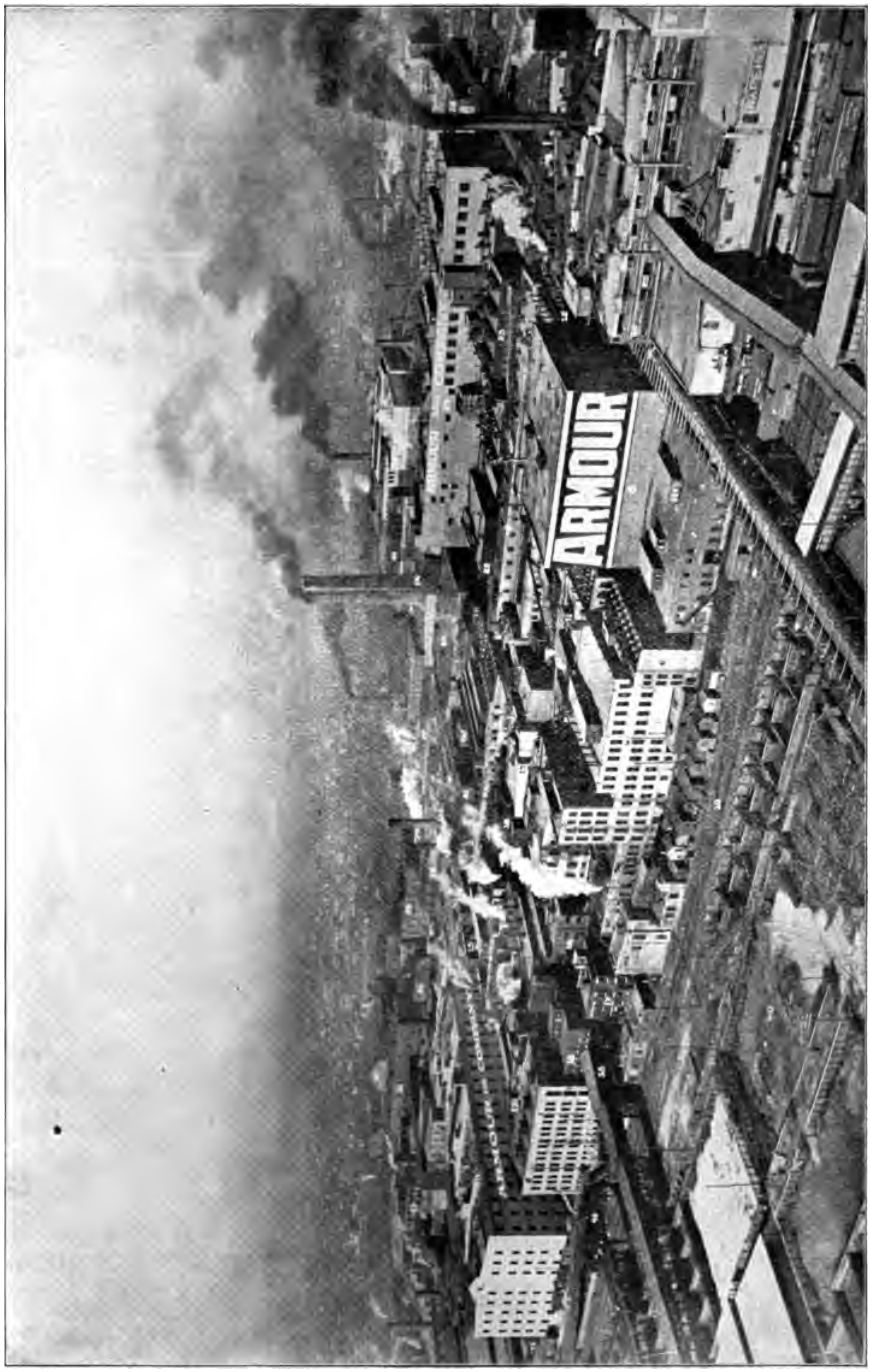
Inside the yards are grouped nearly a score of separate packing houses, all doing an enormous business. There is also a big work of tracks comprising a total mileage of nearly 200 miles.

If the visitor to Chicago wishes to witness a busy scene, let him or her go to the stock yards between 5 and 9 o'clock any week-day morning, and they will see a great horde of people flocking to their daily



GOVERNMENT INSPECTOR.

office building known as the "Exchange Building," which accommodates nearly 300 commission firms, the general offices of the stock yards company, a bank, and a branch of the Bureau of Animal Industry, of the United States Department of Agriculture. Surrounding the yards is a net-work. Inside the yards alone there are regularly employed 33,410 men, women, boys and girls. The early morning is devoted to the unloading of the live stock. After this is accomplished begins the sale. Soon after the sales are made, the stock is weighed to the purchaser, and if it is to be



BIRD'S-EYE VIEW OF THE LARGEST PACKING PLANT IN THE WORLD.

reshipped, is again loaded into cars and forwarded to its proper destination.

GOVERNMENT INSPECTION OF MEATS.

When the cattle, hogs and sheep are in the pens, the government inspectors step in and make a thorough inspection of all live stock received. Condemned animals have a tag fastened in their ears. These animals are slaughtered under the direction of the Bureau of Animal Industry, and, if the meat is found to be diseased, the carcass is condemned and goes into the tank. In addition to this inspection, the Government keeps a man in every packing house in the yards, whose duty it is to inspect all animals slaughtered, and so thorough is the work done that an animal can be traced from the time it arrives at the yards until it reaches the retail butcher's shop.

PORK TESTED BY THE MICROSCOPE.

Pork that is to be exported is subjected to a rigid microscopic inspection, and if found to contain disease of any kind, the carcass in which the disease is found is ordered "tanked" at once. All this work is done by a corps of expert microscopists, under the direction of the chief of the Bureau of Animal Industry. Tiny bits of meat are cut from each carcass that is to be exported, and after being placed in a tin box, are labeled, and later, taken to the microscopic department, where an inspector (usually a woman) cuts the meat into jelly with a tiny pair of scissors, after which the pulpy mass is placed between two pieces of clear glass, pressed together, and then subjected to a powerful microscope. If the meat is diseased, the microscopist

SECTION IN COOLER.

FILLING PAILS WITH LARD.

SKINNING SHEEP.

will immediately discover it, and that carcass will be condemned. In Chicago, there are 90 inspectors at work during the whole year.

PROCESS OF SLAUGHTERING AND DRESSING.

In the great packing houses that abound within the yards, there is a familiar jest, that everything of the animals slaughtered except the squeal of the pigs is saved, and this is to-day literally true, for, that which once was loss is now made into various things. So complete is the utilization of that which was once waste, that the profits of a big packing house on its by-products amount to a small fortune each year. Let us follow the process of a typical packing house from beginning to end. The buyers of the concern purchase such cattle as are wanted for the day, which are driven from the pens over long runways, to the pens of the packing house, which is located near the slaughter house. Some of the packing houses have fat steers trained to lead the other cattle to the foot of the gangway, there to turn and leave them, while the victims go on to their fate. From the gangway there is an incline which leads into a small stall, or pen, directly opposite the killing floor. Above, on small platforms, the "knockers" run along, and with a small sledge-hammer, strike the cattle upon the head until they fall to the floor, stunned. Then the doors open automatically, and a

LOADING INTO REFRIGERATOR CAR.

SCALDING HOGS.

SEWING HAMS FOR EXPORT. By courtesy of Armour & Co.

moment later, the animal is dangling by the hind foot at the end of a long chain, which suspends the carcass high enough for the butcher to cut its throat. The heads are removed at the same time the carcass is drained of blood, and then in quick stages the hoofs, shanks and entrails are removed. The carcass is split down the backbone. It travels along on an endless chain, or trolley, is washed, and later taken into the great coolers to be chilled.

ROUGH FINISHING.

NOTHING WASTED.

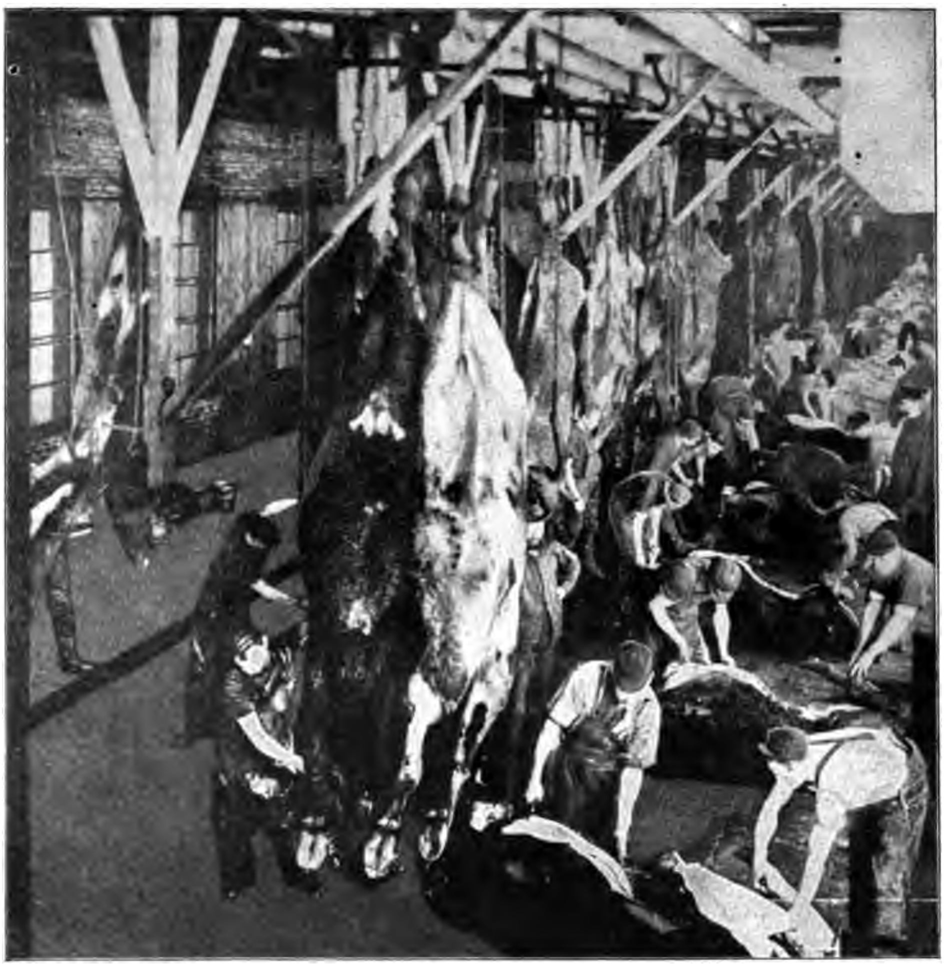
Everything that pertains to a slaughtered beef is sold and put to use. The horns become the horn of commerce; the straight lengths of leg bone go to the cutlery makers for knife handles; the entrails become sausage casings and their contents make fertilizing material; the livers, hearts, tongues and tails, and the stomachs that become tripe, all are sold over the butchers' counters of the nation; the knuckle bones are ground up into meal for various uses; the blood is dried and sold as a powder for commercial purposes; the bladders are dried and sold to druggists, tobacconists and others; the fat goes into oleomargarine, and from the hoofs and feet and

PACKING MINCE MEAT.

"OLEO" AGITATION.

other parts, come glue and oil and fertilizing ingredients.

Directly above the slaughter houses is a series of rooms full of bones and horns. The bones are boiled to get the fat of the marrow as well as to clean them. Then they are dried and shaken about until they are smooth and clean as cotton spools. The knuckle bones are cut from them, and one room is filled with the ground-up pulver of these parts. The white and pretty bones are shipped to Connecticut, England and Germany, to be worked into knife handles, fan handles, tooth-brush handles, backs for nail brushes, sides for pen knives, and into button-hook handles, shirt studs, cuff buttons, and so on, ad infinitum. What is to become of the horns is still more astonishing. By heating them and then tapping them skillfully, the operators loosen the soft cellular filling which solidifies and strengthens each horn. The substance around this, between it and the inner surface of the horn, goes for glue; the rest



SKINNING CATTLE.

SAUSAGE ROCKERS.

CANNING DEPARTMENT. By courtesy of Armour & Co.

is ground up into bone meal. The horns are then sent to makers of horn goods, who, by cutting each horn skillfully and then pressing it between heavy rollers, manage to spread each into a flat ribbon. In this shape, it can be used in a thousand ways. The artificers who do this work cut each horn spirally, so that it becomes a tight curl capable of being straightened out. By immense pressure the curve is taken out of it. Good horns sell for $100 per ton.

REFRIGERATION.

The refrigerating and cooling rooms are kept at a temperature of 36 degrees, yet, when the meat fresh from the slaughter is railroaded into such a room, the animal heat in it warms the room for a considerable time, and fills it with steam as with a fog. As soon as it is cool, the sides of beef become firm, hard and almost appetizing. Everywhere, except at the actual scene of slaughter, these houses and their work are clean and above criticism.

HOG KILLING AND DRESSING.

The killing of hogs is done in a much more peculiar manner than the slaughtering of cattle. The hogs are run into a catching pen, from where they are caught up and forced upon a revolving wheel, where the butcher stabs them to the heart, and death is practically instantaneous. From the wheel the dead body swings along, to be loosened over a vat of scalding water, into which it is plunged. Here the bristles are loosened. Then a great rake scoops out a hog, and it falls upon a runway, where

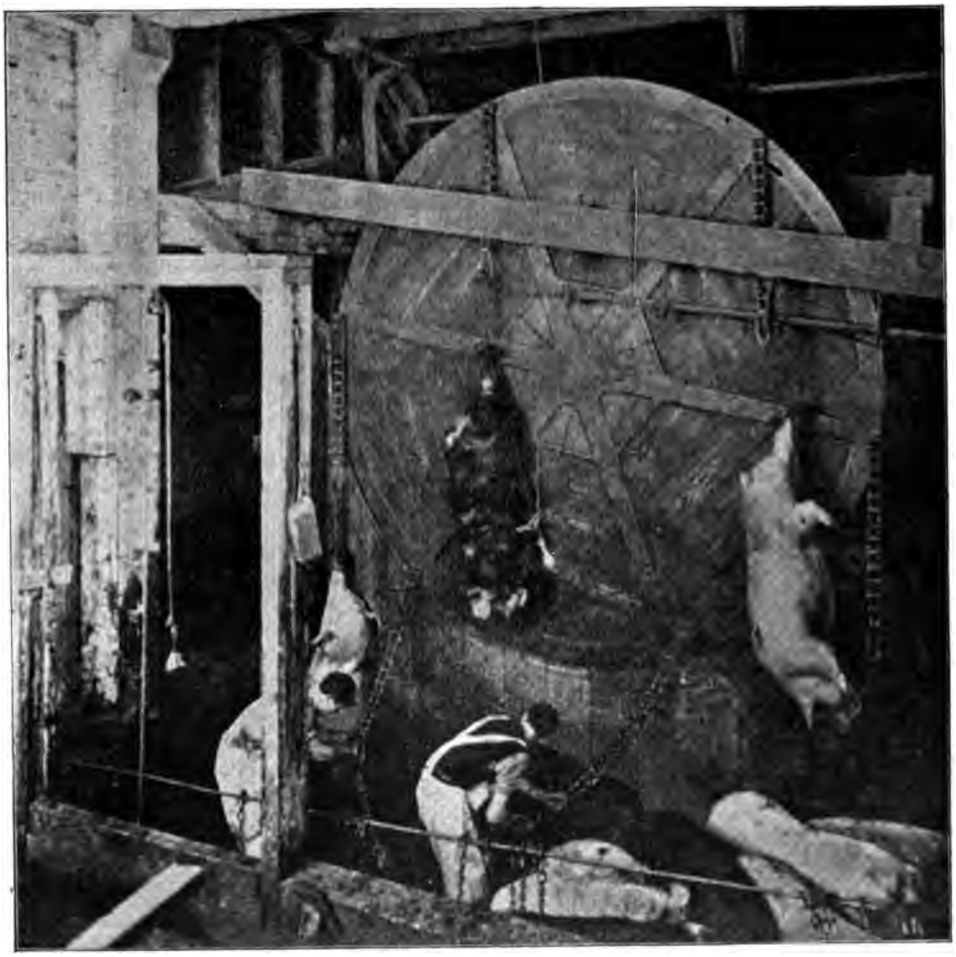
SLIDING ONTO RAIL.

THE CATTLE PENS.

TAKING OUT LEAF LARD.

a chain that is hooked to its nose pulls it through a steam scraper. The knives of this machine are set at every angle, and miss no part of the hide on the body.

When out of reach of the scraper a number of men pass the body along, to remove every bristle and speck that was missed. Then the body is washed with a hose, and its head is almost cut off. Next it is disemboweled. Then the lard is removed, the head is cut off, the tongue taken out, and the body is split and passed along to the cooling room. The blood is turned into albumen for photographers' uses, sold to sugar refiners or transformed into fertilizing powder. The bristles go to brush makers, shoemakers and upholsterers. The fat is valuable in many forms, the intestines become sausage casings, livers, lungs and hearts are made up into sausage meat, and parts of the meat of the heads made up into headcheese. The feet are canned or pickled, or worked up in the lard tanks.



HOISTING ON REVOLVING WHEEL.

SHEEP KILLING.

The method used for killing sheep is similar to that heretofore described, except that they are suspended two by two on hooks that run along a continuous trolley line. As each pair passes the succession of men in waiting, a new step in the process is completed. The killer sticks the knives into their throats at the rate of 25 per minute, and the animals continue to pass through the hands of specialists at that rate of speed, until the carcass appears at the end of the trolley, spread apart with wooden braces, and ready for the refrigerating room.

SHEEP KILLING.

One of the big packing houses, in 1901, did a business of $160,000,000, which is astonishing when one thinks that there are a score or more which do an enormous business. The markets for the products of these American packing houses, of which those of Chicago are but the largest of many great ones in western cities, are found the world over. It would be hard for any European power to go to war without patronizing the American packing houses for their meats and supplies. During the Spanish-American war the United States government drew on them heavily, and when England was fighting the Boers the American packers did an enormous business.

RUMPING AND BACKING.

KILLING "KOSHER" CATTLE.

For Jewish customers, meat must be dressed with especial religious rites.

In closing this article it is proper to mention a peculiar

feature of the yards, viz., the killing of cattle intended for the Jewish markets. For this purpose a "Kosherman" is in attendance, who, as a steer is thrown upon its back, with legs bound, takes a razor-like knife and makes a stroke forward and a half stroke backward upon its throat. After the carcass is dressed it is hung up, and remains thus about four days, the rabbi washing it carefully each day. He then officially marks it as fit for consumption by those of his faith.

PUTTING UP SAUSAGES.

No country in the world, unless, possibly, South America, breeds mules so extensively as the United States, or regards their usefulness so highly. Their value in some sections of the country is manifested in the statement of a veterinary periodical, that 100 mules were sold not long ago in Scott county, Kentucky, at $177 each.

The perfection to which mule breeding has attained in this country, so far as development in size and strength is concerned, is shown by a recent advertisement offering

By courtesy of the Lawrence Photographing Co.
THE GREATEST HORSE MARKET IN THE WORLD.
DEXTER PARK PAVILION, UNION STOCK YARDS, CHICAGO.

THE LONGEST TAILED HORSE IN THE WORLD.

This remarkable animal was bred in Lexington, Ky., and attracts great attention at stock shows in Europe. His tail is 19 feet long, mane 12 feet and forelock 8 feet. He is a chestnut and stands 15½ hands. The last selling price for the horse was $20,000.

for sale two black mules, three years old and 17 hands and 3 inches high. It is not uncommon in Pennsylvania and New Jersey to see teams of mules on heavy work which stand 16 and 17 hands in height.

In no other part of the world are mules of this size bred. In most countries large animals of this species are not regarded with favor, 14 hands being deemed the proper limit. The mule will do double the amount of heavy road hauling and work on the farm that is possible for the average horse, requires but two-thirds the food and half the attention demanded by the latter, and can be depended upon, as a rule, for more than double the number of years of service.

SCENE ON A MULE FARM.

CONSTRUCTION OF THE "SKY-SCRAPER"

FLATIRON BUILDING, NEW YORK CITY.

Great has been the progress in building in the last decade. Time was when a ten-story office building would have been deemed an affront to Providence. But with the invention of the modern elevator and the rapid advance of land values in great cities, architects and contractors began seriously to study out methods for accommodating great numbers of tenants in individual buildings. As long as buildings had to be constructed solely of brick and masonry there was a definite limit to their height, for, as the height grew so grew the weight of the walls and further altitude had to be sacrificed when it became impossible to fit the walls to carry the height without undue expenditure.

At the junction of Fifth avenue, Broadway and Twenty-third street, New York, stands a unique structure, probably the strongest ever erected. It is known as the "flatiron" building, and is the cumulative result of all that is known in the art of building. It is equipped with every convenience that human ingenuity could devise.

BUILDING WALLS FROM THE UPPER STORIES DOWNWARD.

Suddenly there appeared an engineer who solved the problem by propounding the idea of building steel structures after the fashion of gigantic bridges set on end, and to hang the walls on—that is, to make the girders and beams support the floors and walls, instead of making the walls support everything. This was called Chicago construction, because it originated with a Chicago man. Building under this method each floor is absolutely independent so far as the walls and partitions are concerned, for the walls have

MONADNOCK BUILDING, CHICAGO, ILL.

The largest office building in the West; 17 stories high, covering an entire block, facing four streets. Architects, Messrs. Holabird & Roche; builders, The Geo. A. Fuller Co. Sixteen hydraulic elevators. Original cost $2,800,000. Occupants, 7,000 (equal to the population of a small town). 24,000 people carried by elevators each day. 12 horizontal tubular boilers 1,800 horse power, all equipped with smokeless furnaces.

nothing but their own weight to carry in the height of each story. It is no uncommon thing on "Chicago-construction" buildings for the contractor to begin his exterior work on the third, fifth or ninth story, leaving the first to be enclosed after every other floor has been walled in and plastered. This method of building is diametrically opposed to the old-fashioned solid-masonry construction, which begins at the very bottom with the foundation and rises to the roof, with the piers, exterior walls and partition walls going up together. The contractor, building a skyscraper according to "Chicago construction," shoots the steel frame-work up as rapidly as possible, so as to get the roof on to protect the interior from the weather. With the frame-work up, he puts in the hollow tile partitions or builds the walls to suit his convenience. This method of building set all traditions, rules and time-honored customs of architects and builders at naught, for it ignored massive foundations, heavy piers, the use of thick walls to carry weight, and solid partition walls running from the foundation to the roof.

When new tenants moved into old-fashioned buildings, the rearrangement of spaces to meet the tenants' requirements frequently necessitated expensive alterations, for the partitions could not be moved without substituting some other form of supports for the floors above. Chicago's architectural engineers concluded that columns starting from the foundations could carry the floors as well as partitions, and would thus permit any arrangement of a floor without interfering with the construction.

High buildings required monstrous foundations and very thick walls under the solid masonry style of construction. The limited areas in the cramped business districts of the cities made it impossible to build 16-story buildings under old-fashioned methods because the builder could not get "spread" for his foundations, and the original soil of Chicago was not adapted for carrying weights on small areas.

THE ARCHITECTURAL IRON WORKER.

This style of new building developed a new craft—that of the architectural iron worker—who is a mixture of a bridge builder and a sailor. He must be a rigger as well as an iron worker, and must be able to tread the beams high in the air with the confidence and nerve of a tight-rope dancer. The building up of the great structures in the business center provided another source of wonder and admiration for the gaping crowds that watched the daring workmen riveting together angles and beams hundreds of feet in the air. Many sailors left the lakes and became iron workers, and the craft grew until it became one of the largest and strongest of unions.

OLD AND NEW STYLE FOUNDATIONS.

In solid masonry construction the foundations are made of heavy stones piled on each other so that they are broad at the base and somewhat pyramidal in form. On the foundation the massive piers rise, well-nigh filling up all the space in a basement. Under present methods of construction a basement, so far as room is concerned, is as valuable as the other floors, for the slender columns shoot up from the foundations, occupying comparatively little space. In "Chicago construction," the foundations are made of steel railroad rails or beams.

MASONIC TEMPLE, CHICAGO.

The largest building ever attempted by a charitable or social organization. It is twenty stories in height (265 feet), and has a west frontage of 170 feet and a north frontage of 114 feet. The first three stories are constructed of Wisconsin granite, and above them the material is gray fire-brick. The number of people engaged in the stores and numerous offices of the building is about 7,000.

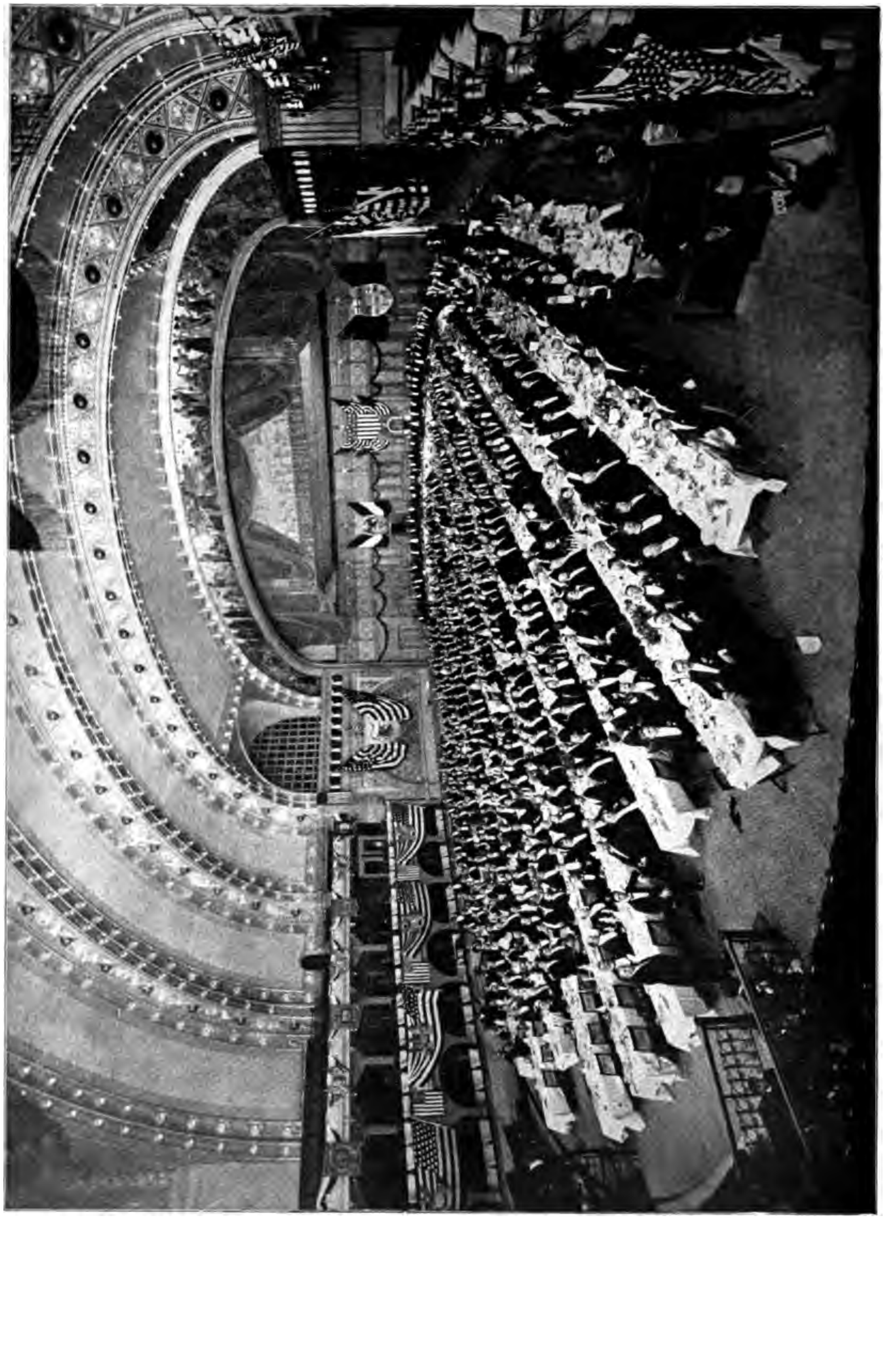
HAVEMEYER BUILDING, NEW YORK CITY.

First a bed of concrete is laid, and on this is placed a layer of rails or beams set side by side. On this bottom layer another layer of rails or beams is laid, crossing the lower members of the foundation at right angles. On top of the rails a cast-iron plate is laid. This is the shoe for the steel column.

THE COLUMNS.

The column is always made of wrought steel shapes and it is of uniform size for each of two stories, diminishing in size as it nears the roof. The floor beams are carried on the columns and the entire frame-work is riveted together with hot rivets, just as a bridge is. Architectural engineers say that if it were possible to upset a building of the "Chicago-construction" kind, the whole structure would tip over like a box and would not fall into pieces as a solid-masonry building would. An earthquake might rattle down some bricks, or loosen some partitions, but, according to claims made by Chicago builders, it would not throw down a Chicago sky-scraper.

THE AUDITORIUM, CHICAGO.
Containing the largest auditorium in the world, also Auditorium Hotel.



By courtesy of the Lawrence Co.

Banquet at the Auditorium Hotel, tendered President McKinley, on His Last Visit to Chicago.

FIREPROOFING.

Every piece of exposed steel work is completely surrounded with some fireproof material, such as blocks of tile, terra cotta or brick, and air spaces are left between the fireproofing material and the metal, for dead air is one of the poorest conductors of heat known. The hollow tile arches, placed between floor beams, are covered over with thick concrete, and this concrete is fireproof. The partitions are of hollow tile, which is not only light as compared with brick, but is fireproof as well; and it is said that buildings of "Chicago construction" are as nearly fireproof as it is possible to make them. The average thickness of the walls of a modern skyscraper runs from 16 to 18 inches, the walls carrying about the same thickness from the ground up. This is a radical departure from the old-fashioned construction, for the walls of the lower floors of 15 stories of solid masonry would have to be at least three and a half feet thick, and would drop off about four inches for every two floors above the third. This thinness of walls in Chicago buildings has its disadvantages from the point of view of the architect, for it gives a "skimpy" look to the building, but to the ordinary man they are simply wonders.

By courtesy of Lawrence Photo. Co.

CHICAGO POSTOFFICE.

MARVELOUS DEVELOPMENT OF PRINTING APPARATUS


OLD-STYLE SCREW PRESS.

The first method of printing known was that of the Chinese which was done from engraved blocks, a brush being rubbed over the paper laid upon the form of type. As early as the 15th century, the principle of printing from forms upon a flat bed beneath a cylinder was understood and put to practical use. The presses, however, were wooden and rudely formed.

FIRST USE OF MOVABLE TYPES.

In the middle of that century Gutenberg printed a book from movable types. Two upright timbers with crosspieces of wood at the top and bottom constituted the outer frame of his press. Other crosspieces held the flat bed containing the type, and through still another intermediate slot passed a wooden screw, its lower end touching the center of a platen of wood and screwing it down upon the type.

The form was inked with a ball of leather stuffed with wool, upon which the paper was laid. On this paper a fragment of blanket was spread to make the platen smooth and soften the impression. The idea of the machine was based on the cheese and linen presses used in medieval households. The type of the present time is practically identical with that used by Gutenberg in printing his Bible.

For about 150 years the wooden press, operated with a screw and movable bar, was used without much modification. The forms, however, sometimes rested upon stone beds held in frames styled coffins, and were moved by hand. The platen was screwed up with the bar after each impression, in order to withdraw the printed sheet and hang it up for drying.

BLAEW'S IMPROVED PRESS.

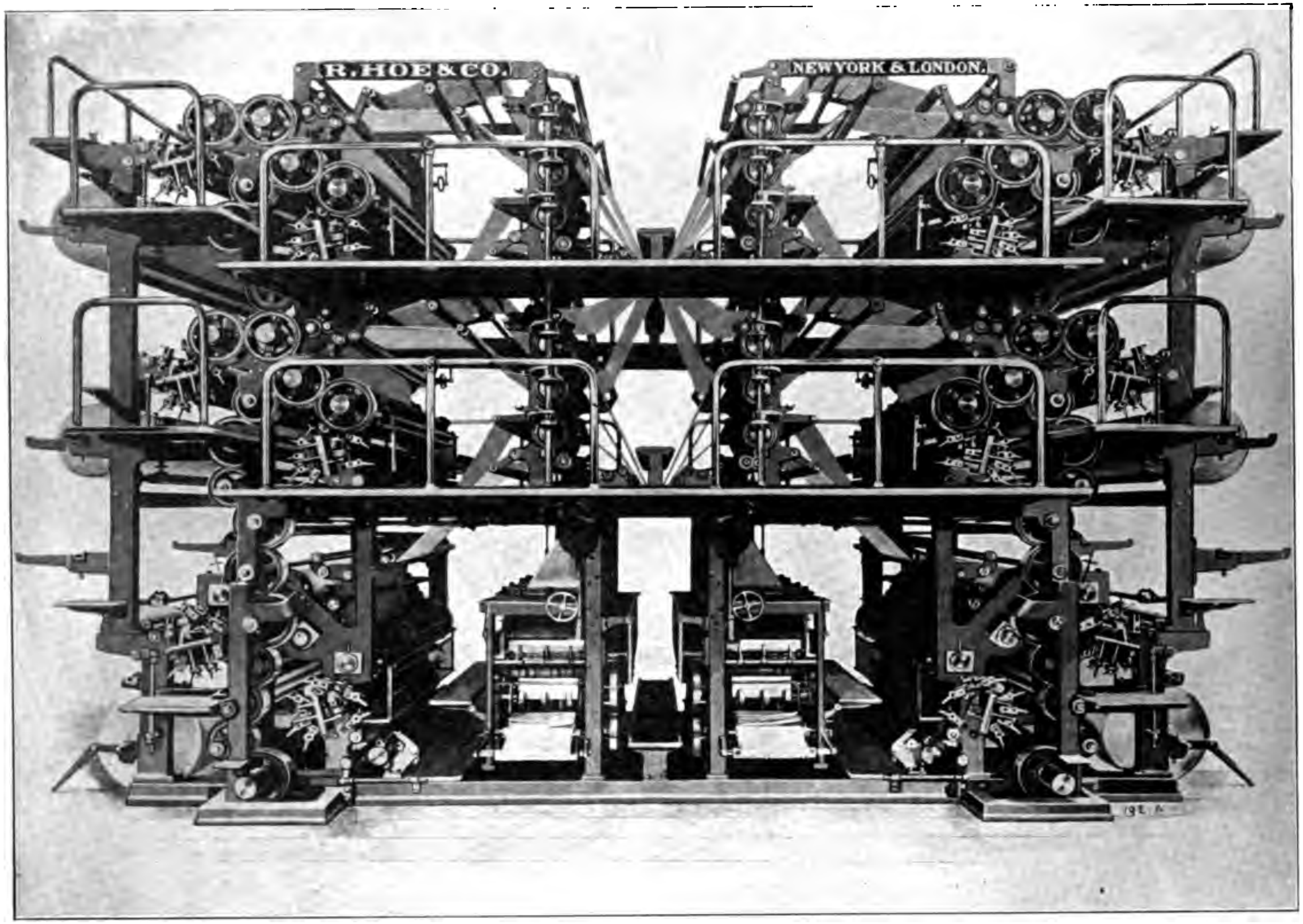
About the year 1620 this press was first improved by a printer, of Amsterdam, named William Jensen Blaew. He ran the spindle of the screw through a square block guided in the wooden frame, and by cords or wires suspended the platen from this block, which prevented the platen from twisting and equalized the motion of the screw. This press was used in England and on the continent, and was nearly identical with that operated by Benjamin Franklin when he worked as a journeyman in London.

FIRST CAST IRON PRESS AND FIRST LEVERS USED.

About the close of the 18th century it was found necessary, particularly in the printing of wood cuts, and because of the size of larger forms of type to secure greater power for the impression. This led the Earl of Stanhope to construct a frame of cast iron, and, to facilitate the manipulation of the screw, he added a combination of levers which enabled the pressman to bring more force to bear, with less exertion.

FIRST PRESS WITHOUT A SCREW.

Shortly after the year 1800, George Clymer, of Philadelphia, contrived an iron



DOUBLE SEXTUPLE AND COLOR COMBINATION PRESS AND FOLDER.. By courtesy of R. Hoe & Co,
Running Speed, per Hour, when printing in black alone: 96,000 4, 6, 8, 10 or 12-page Papers; 48,000 18, 20, 22 or 24-page Papers; 72,000 14 or 16-page Papers; 36,000 28 or 32-page Papers.

machine without a screw. Over the platen was placed a long, heavy, cast-iron lever. One end of this was fastened to an upright of the frame, and the other end was raised and lowered by a combination of smaller levers operated by the pressman in a manner similar to that of the common hand press. A spindle or pin, attached at the top, to the center of the large cross lever, and properly balanced raised and lowered the platen when making the impression. This press was used in England.

FIRST FLAT-BED CYLINDER PRESS.

Friedrich Koenig, of Saxony, introduced the first press of the above description into use in England in 1812-13, and in 1814 he patented a continuously revolving cylinder press which printed one side of a paper at the rate of 800 sheets per hour.

SCREWS AND LEVERS REPLACED BY TOGGLE JOINT IN PETER SMITH'S INVENTION.

Peter Smith, of New York, who was associated with R. Hoe & Co., contrived a cast-iron press in 1822, in which he replaced the screw and levers with a toggle joint, which simplified the operation of the machine and rendered it more effective.

RUST'S IMPORTANT IMPROVEMENT.

Smith's invention was greatly improved upon in 1827 by a device perfected by Samuel Rust, of New York, in which the frame was not all of cast-iron, but had the uprights hollowed for the introduction of wrought-iron bars fastened to the top and bottom of the casting. This feature greatly lessened the quantity of metal in the press, while adding to its strength. Rust's patent was bought by Hoe & Co., who improved it materially and manufactured and sold it extensively.

In this press (the Washington) by turning a crank, with belts attached to a pulley upon its shaft, the bed is run out and in from under the platen on a track. The platen is raised by springs on each side, and a curved lever acting on a toggle joint impresses it upon the form. A tympan frame covered with cloth and inclined so as to receive the sheet of paper is attached to the bed. Another frame, the frisket, covered with a sheet of paper, is attached to the tympan. That portion of the sheet which would naturally receive an impression is cut away, as, otherwise, the chase and furniture would smear it. Over the sheet and tympan the "frisket" is turned down, and in making the impression all are folded together. The machine has automatic inking rollers, which the pressman operates by a weight. The descent of the weight draws the rollers over the type and returns them to the inking cylinder, while the pressman places another sheet upon the tympan.

Hoe & Co. also improved this press by providing a steam-driven apparatus, which distributes the ink on the rollers and makes them move over the type at will.

Fine books and cuts were commonly printed by the bed and platen method until 1850, the first steam-power, wooden press of this kind having been made by Daniel Treadwell, of Boston, in 1822.

The next improved press of Hoe & Co. printed papers of four, six, eight, ten or twelve papers at the rate of 24,000 per hour and sixteen-page papers at 12,000 per hour, the odd pages being in every case accurately inserted and pasted in and the papers cut at the top and delivered folded. The machine is constructed in two parts, the cylinders in one portion being twice the length of those in the other. The short

cylinders are used for the supplements of the paper, when it is desired to print more than eight pages. The plates being secured on the cylinders, the paper enters from the two rolls into the two portions of the machine, through each of which it is carried by two pairs of type and impression cylinders, and printed on both sides, after which the two broad ribbons or webs pass over turning bars and other devices, by which they are laid evenly, one over the other, and pasted together. The webs of paper then pass down over a triangular "former," which folds them along the center margin. They are then taken over a cylinder, from which they receive the final fold, a revolving blade within this cylinder projecting and thrusting the paper between folding rollers, while at the same moment a knife in the same severs the sheet and a rapidly revolving mechanism resembling in its motion the fingers of a hand causes their accurate disposal upon traveling belts, which conveys them on for final removal.

What is known as the "Quadruple Newspaper Press," constructed in 1887, was developed to a greater extent. The supplement portion of the press was increased in width, and by ingenious devices the press was made to produce eight-page papers at a running speed of 48,000 per hour; also 24,000 per hour, of eight, ten, twelve, fourteen or sixteen-page papers, cut at the top and pasted and folded, ready for the carrier or the mails.

In 1889, R. Hoe & Co. made the "sextuple" machine, which occupied about eighteen months in construction, and is composed of 60,000 pieces. It is fed from three rolls, each being more than five feet wide. In a single hour it will use up twenty-six miles of this paper. It can print and fold 90,000 Heralds in an hour, which means 1,500 copies per minute, or twenty-five copies every second.

The latest and most elaborate newspaper machine is the Octuple Perfecting Press with Folders, which prints from four rolls, each four pages wide; and gives (from the four deliveries) a running speed per hour, of 96,000 four, six or eight-page papers; 72,000 ten-page papers; 60,000 twelve-page papers; 48,000 fourteen or sixteen-page papers; 42,000 eighteen-page papers; 36,000 twenty-page papers; and 24,000 twenty-four page papers.

A RAILROAD ENCIRCLING THE GLOBE

An American syndicate has offered to complete the building of the Siberian Transcontinental Railway, from its present terminus at Vladivostok in southeastern Siberia to Cape Numiano, on Bering Strait.

RUSSIA SPENDS $400,000,000 ON ROAD.

Russia has already built 5,542 miles of the Siberian Railway, at a cost of $400,000,000. This has, of course, been a drain on the treasury, and on the physical resources of that frigid country, since the services of 70,000 men have been required for a period of nearly ten years.

In connection with this enterprise, the American syndicate has figures giving every elevation, every grade and every item of engineering data necessary to the building of a standard gauge railway from the northwestern terminus of the Canadian Pa-

cific Road at Edmonton or Quesnella, to Vladivostock, including the crossing of Bering Strait.

This great, ambitious, Alexandrian scheme would encircle the earth with a double band of steel and the construction and operation of a railway system 20,000 miles in extent, traversing three continents, with one terminus at Calais on the channel coast of France and the other at New York City.

depth from 800 to 5,000 feet and occupies an area of 12,000 square miles, with a minimum width of thirty miles.

This great body of water has a distinct ebb and flow and current, and its high altitude has made it peculiarly the home of violent storms and intense cold. It was determined at first to ferry the trains over this gap, and for that purpose a steel ice-crushing ferry boat was built at a cost of $1,000,000.

TYPICAL RUSSIAN LOCOMOTIVE IN URAL MOUNTAINS.

ON THE RUSSIAN SIDE.

On the Russian side the czar's engineers have made an accurate survey of the ground, and they have found no such obstacles along the route as those which have already been overcome in building to the present terminus; for instance, that at Lake Baikal. This is a great inland fresh water lake, 1,560 feet above sea level, in a clef of the Baikal Mountains. It ranges in

But the incapacity of so cumbersome an arrangement soon became manifest, and the great thickness of the ice even further limited its usefulness, so that it was decided to build around the south, and this is now being done.

Bering Strait, between Capes Numiano, Siberia, and Prince of Wales, Alaska, is a fraction more than nineteen miles wide—a lesser distance than from Dover to Calais—

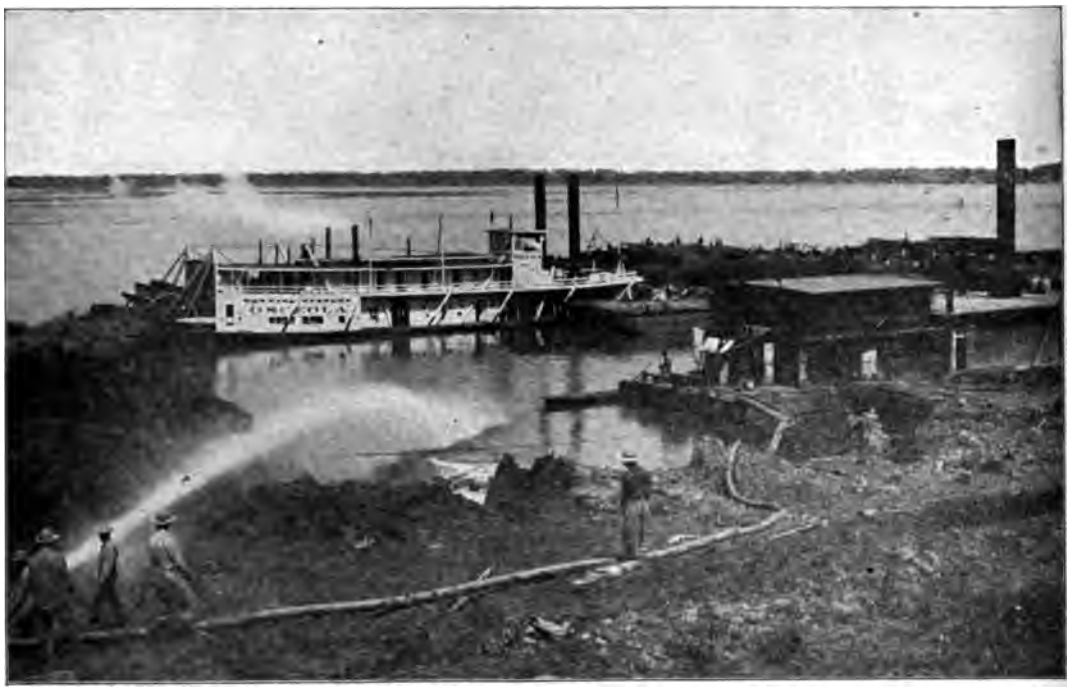
only one-fourth the width of the Yukon River, 1,200 miles above its mouth.

TUNNEL UNDER SEA.

The American project involves a tunnel for Bering Sea, which will not be nearly so difficult a matter as it would appear at first glance. To begin with, the Diomede Islands would break the continuity of a tunnel twice, so that no section of it need be more than six or seven miles long.

The czar spent $400,000,000 building 5,542 miles. The new road, to make connections at both ends, will be just about that length—perhaps 1,000 miles less.

One inducement on the part of the czar to accept the syndicate's offer is the fact that there is no more fertile land anywhere than southeastern Siberia, and its millions of square miles of grazing and farming and fruit lands would support almost the world, if they were employed. They have been opened and worked just sufficiently to demonstrate their value. The mines of the farther north and in the mountains are among the richest on earth in gold, copper, coal, platinum, silver, salt, iron, lead, zinc and tin.



REMOVING BENDS IN RIVER.

ON THE AMERICAN SIDE.

On the American side, the wealth of Alaska and the Northwest Territory is just becoming apparent. There are hundreds of millions of acres of lands needing only that little impetus of the iron horse to develop them into the richest the world has ever known. While the summers are short, the days are twenty-four hours long, and vegetation grows all those twenty-four hours.

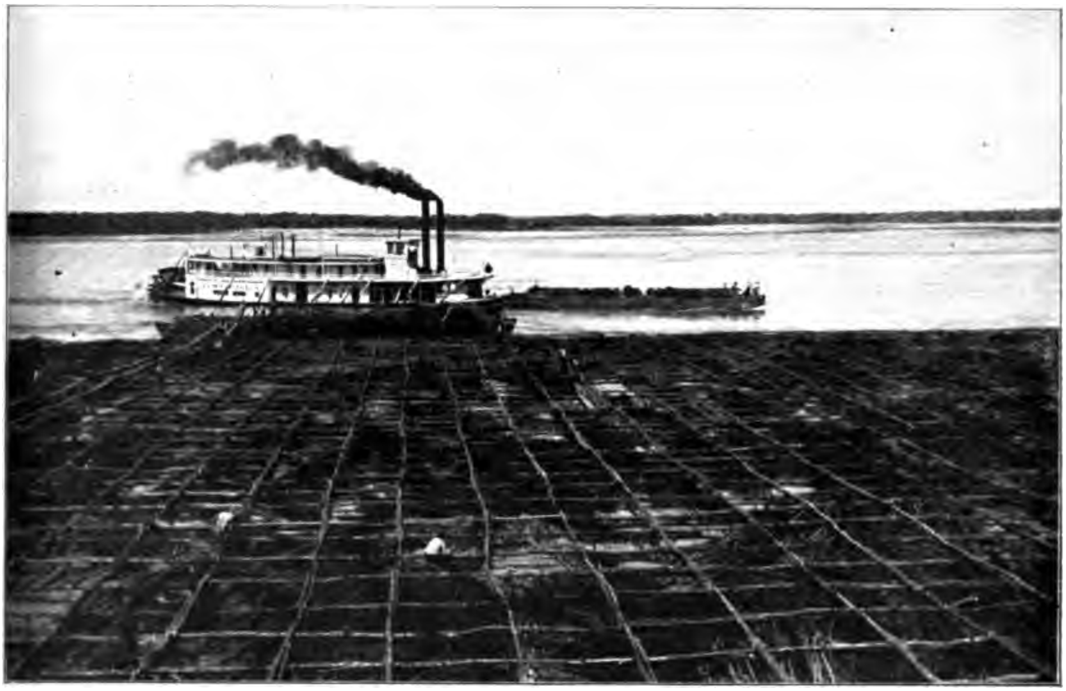
Illinois will not raise such wheat. Puget Sound never saw such vegetables, and California never dreamed of small fruits in such prodigal profusion as grow wild in the valleys of Alaska.

The waters of Bering Sea and the Arctic and of the internal fresh water lakes and rivers will furnish enough fish to feed the world if need be, and the waters being extremely cold, the northern fish are noted for the delicacy of their flavor and the firmness of their meat.

There is that other phase of the proposition, however, that must appeal to all namely, the saving in time in traversing the earth or any portion of it. Within ten years one may girdle the earth within twenty days.

UP-TO-DATE DREDGING MACHINES.

The United States government is father to all the rivers and harbors within the country's borders and one of Uncle Sam's biggest tasks is to dredge away the slime, ooze and formations which tend to fill up navigable waters. For this work great dredges are necessary. The machines which serve the government are similar to those that are used by individuals in digging artificial lakes or altering the landscape in many ways.



HOW THE U. S. GOVERNMENT PROTECTS THE RIVER BANKS FROM WASHOUTS. MISSISSIPPI RIVER.

Several varieties of dredges are used; one, the dipper dredge, which scoops out the mud as a man would with his curved hand; another, the clam-shell dredge, which goes down like an open clam-shell and comes out with it closed and the load inside; and third, the new hydraulic dredge, which thrusts its snout down into the mud, sucks it up and vomits it forth through a long

tube into a barge or upon the shore. The old-fashioned bucket-ladder-dredge has been used very little of late years.

THE DIPPER DREDGE.

The dipper dredge is comparatively a simple affair. It consists of a huge iron scoop at the end of a long arm and hung to a heavy derrick at the end of a barge. The arm is driven by a powerful engine and descends almost perpendicularly into the stream to be dredged. It is scraped along the bottom by means of a chain attached to the end of the arm, and when it is filled and is pulled to the surface the bottom of the scoop is opened by pulling a rope and loosening a pin. Then the load slides out.

THE CLAM-SHELL DREDGE.

The clam-shell dredge is made of two separate scoops hinged together at the upper part. The arm of the dredge is shot down into the mud and the scoop sinks into it. As soon as the derrick raises the arm the jaws of the dredge come together. When the load has been brought up, a simple device releases the jaws and the load falls out.

Where streams are loaded with mud, or where canals are being dug in very soft mud, the hydraulic dredge cannot be improved upon as a digger. This dredge is equipped with a suction pump, a powerful engine, a long, hollow arm which reaches down into the mud, and a cutter at the end of the arm supplied with steel knives which burrow into the soil and loosen the mud so that it can be drawn up easily by the suction pump.

The operation of this dredge is simple. When the barge is in position a big post is shoved down into the mud and the barge is

HOW THE UNITED STATES GOVERNMENT PROTECTS ITS BANKS FROM WASHOUTS.

anchored to it. Then the spout is shoved down into the mud, the engines started and the cuter and pumps loosen and bring up the mud. When the mud has been brought to the surface it is often run directly into a mud scow, but sometimes it is carried through piping 1,000 feet or more, and dumped on shore. When one spot in a river has been scooped clean, the anchoring post, or "spud," is drawn up and another post is set out behind by machinery, to force the barge along. So great is the capacity of these dredges for cutting and drawing up mud, that one of them pumped up more than 165,000 cubic yards of mud in twenty days.

MAMMOTH CATERING ENTERPRISES

By courtesy of Libby, McNeill & Libby, Chicago.
METHOD OF COOKING MEATS FOR CANNING.
Monthly output, 10,000,000 cans.

The methods of those great enterprises which cater to the appetite of millions of people throughout the world furnish an interesting study. To the multitudes who partake of the tempting products of these establishments, the extent and variety of their output is little understood, and the degree to which the delicacies therein manufactured tend to lessen the culinary labors of the average household, especially in the summer season, is hardly realized.

COOKING AND CANNING FOR THE MARKET.

Among the mammoth concerns which fill the world's mouth with skillfully contrived edibles, one, located in Chicago, may be taken as a representative plant, for the purpose of this article.

FIFTY ACRES OF FLOOR SPACE USED BY ONE CONCERN.

The cooking and canning facilities of this company cover a space of six acres and

By courtesy of Libby, McNeill & Libby, Chicago.
HEADING AND SOLDERING CANNED MEATS.

SWIFT & CO.'S OFFICE, CHICAGO—LARGEST PRIVATE OFFICE IN THE WORLD.

include a floor area of fifty acres. The department devoted to cutting meats has a capacity of disposing of 250 cattle per hour, and 15,000 cattle are slaughtered weekly in the plant. Its power-house refrigerator contains eighteen boilers, with a capacity of 750 tons per day.

PREPARING JEWISH MEATS. (KOSHER.)

MONTHLY OUTPUT 10,000,000 CANS OF FOOD.

The number of people employed in the concern is 3,000 and their annual earnings amount to about $15,000. These toilers handle 10,000,000 cans of prepared meats, soups, etc., every month, which necessitates the use of 500,000 boxes of tin plate annually.

A LUSCIOUS VARIETY OF APPETIZING PREPARATIONS.

Among the specialties in delicatessen manufactured by this concern may be mentioned the following: Veal loaf, Melrose pate, luncheon loaf, lunch tongues, ham loaf, beef loaf, chicken loaf, Vienna sausage, club-house sausage, sliced smoked beef, corned beef hash, potted and deviled meats, turkey and tongue, boneless chicken, and ten varieties of soups. These are put up in packages running from one-quar-

CANNING BEANS. By courtesy of the H. J. Heinz Co.
The above-shown plant has a capacity of putting up 40,000 cans of beans per day.

ter of a pound to six pounds. This is but one of several vast establishments engaged in the same industry, and in the same locality. Taken together, their product is sufficient to supply the demand of the entire world for goods of this description.

TURTLES AS BROUGHT INTO MARKET.

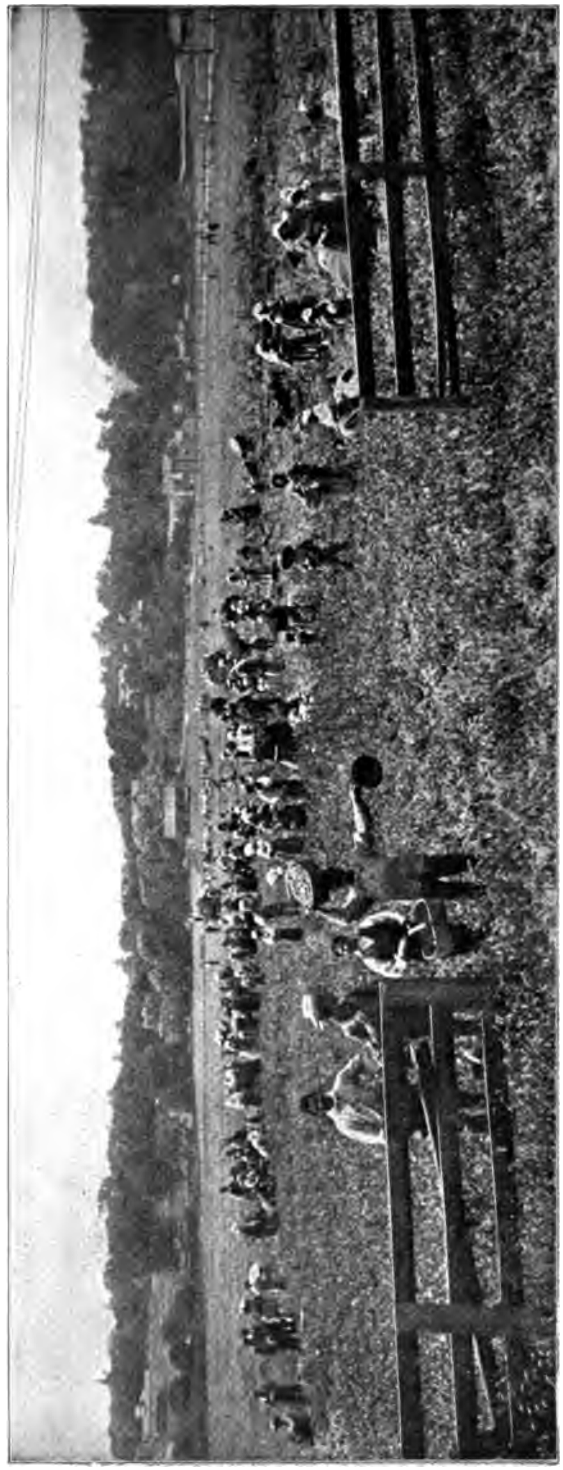
TURTLES BEING PREPARED FOR SOUP.

By courtesy of the H. J. Heinz Co.

BOTTLING PICKLES.

15,000,000 of bottles are here put up each year.

DRAY-TEAM OF LIBBY, McNEIL & LIBBY— ONE OF THE GREAT PACKING FIRMS OF THE UNITED STATES. By courtesy of Lawrence & Co.



A GREAT INDUSTRY—PICKING PEAS AT MOUNT MORRIS, ILLINOIS. By courtesy of the Detroit Photographic Co.

SALMON CANNERY NEAR NEW WESTMINSTER, BRITISH COLUMBIA
Few Know the Importance of This Industry.

AUSTRALIA'S GREAT RAILWAY PROJECT

HOW ONE OF THE GREAT COLONIES PROPOSES TO HELP HERSELF.

Australia is the latest country to catch the transcontinental railway fever and, with an energy characteristic of pioneer lands, has taken the most direct way of getting what it wants. The Parliament of South Australia has formally invited capitalists of Europe and America to bid for the contract of connecting the city of Adelaide on the south coast with Palmerston on the north coast.

BONUS OF 90,000,000 ACRES OF LAND.

Ninety million acres of land along the right of way, with all the minerals and other sources of wealth they may contain, are offered as a bonus to the company that has the courage to undertake a project that will cost from $30,000,000 to $40,000,000, and to operate a railroad through twelve hundred miles of semi-desert land that has only one white inhabitant to every three square miles. But 90,000,000 acres of land, even in the most unpromising region on the earth's surface, may well be a temptation when it is offered at forty cents an acre; and capitalists are not so much afraid of big railway ventures now as they were before the Union Pacific was finished, thirty-five years ago.

England is constructing the "Cape to Cairo" to connect Egypt with Cape Town, and Belgium, England and Germany will cross this line in the Congo country with a road running from the Atlantic to the Indian Ocean. It is now possible for passengers to step on board a train in any European capital and steam away across Central Asia for Canton, China, over the Chinese-Eastern Railway.

DIFFICULTIES OF BUILDING ACROSS AUSTRALIA.

In many ways this proposed Australian railway line, when it comes to be built, will encounter the same difficulties that were met in the building of the Union and Central Pacific roads. There is no mountain system to be crossed and no great rivers to be bridged, but there are broad reaches of desert as hot as those of Arizona and so little known that the maps show blank spaces for hundreds of miles in extent. All Australia taken together is within 50,000 square miles as large as the United States. In the interior deserts ten states as big as Pennsylvania could be dropped down and lost.

Although the distance to be covered is only 1,200 miles, or as far as from New York to the Mississippi River, the cost will be something enormous, and the returns must, for years, be a matter for conjecture rather than a matter that can be figured out.

The bonus offered is about 15 per cent of the entire area of South Australia. The United States gave only 25,000,000 acres to the Union and Central Pacific for building a road twice as long.

It is confidently believed in Adelaide that Canton, China, is to be the great port of debarkation for European traffic to the east, and that Palmerston, South Australia, only ninety-six hours from Canton by fast steamer, is to become the great Australian seaport to connect with Europe.

BIGGEST SHIPS AFLOAT

Steamship records, both for speed and size, have been broken of recent years.

THE CELTIC.

One of the greatest steamships now in operation is the Celtic. This vessel is 700 feet long, 75 feet beam and 49 feet deep. She is equipped with twin screws and can develop seventeen knots an hour. About 260 tons of coal daily are necessary to run her. Compare with these dimensions the first ship of the White Star line, the old Oceanic, built in 1871, which was 420 feet long, 41 feet beam, 31 feet deep, had an average speed of fourteen knots, and consumed sixty-five tons of coal a day. The speed of the Celtic is about 25 per cent greater than that of the Oceanic. She has nine decks, with complete accommodations for 3,294 persons. It takes 350 people alone to look after the wants of the passengers. The steerage accommodations are better than the best quarters for saloon passengers a generation ago. The Celtic has eight double-ended boilers, each with four furnaces, to furnish power for the quadruple-expansion twin engines. She has four masts and two smoke-stacks. Over two million rivets were used in her construction. Nearly 1,400 shell plates of an average size of 30x5 feet and about four tons' weight were used in the hull, and 13,000 more were used in other parts. The Celtic cost about $2,500,000.

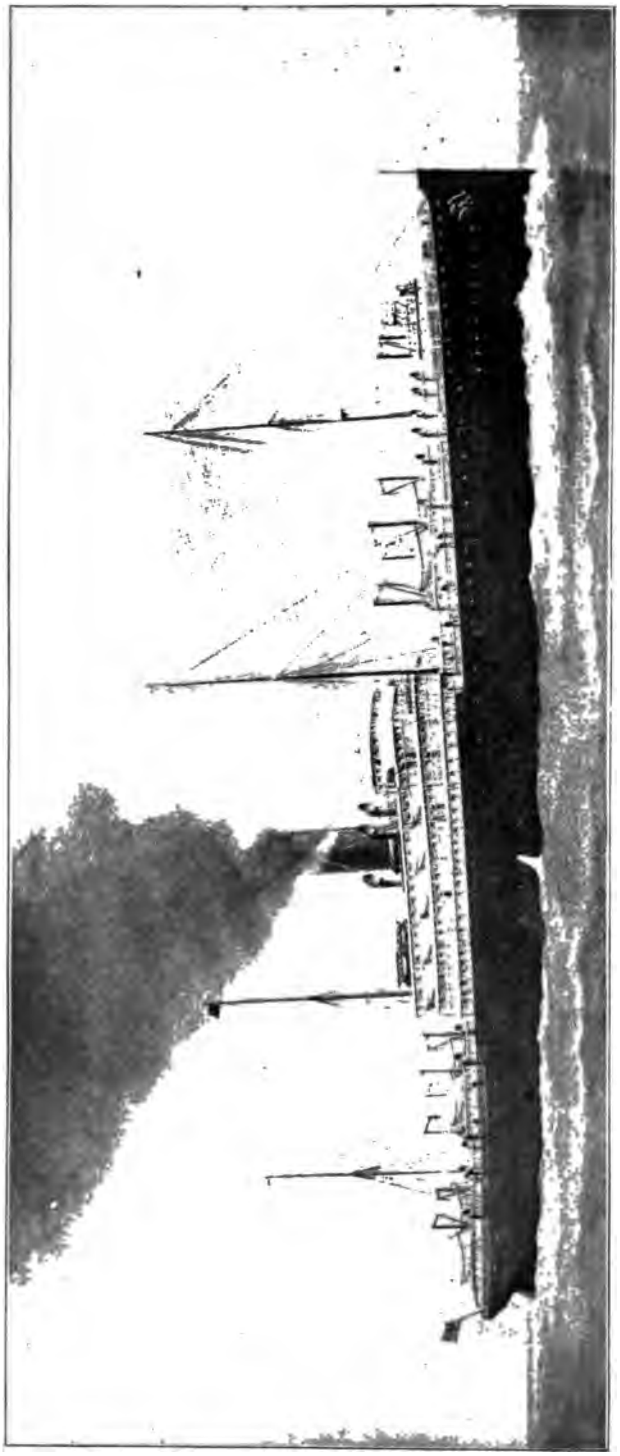
For certain kinds of trade it has been found that sailing vessels of great size are very profitable. As a result, two great six-masted schooners and one seven-masted schooner have been lately built. In carrying lumber and the like these vessels have made a handsome return on the investment. It is a noticeable as well as important fact that they are built of steel. In fact, it is only by the substitution of steel for wood that seven-masters are possible.

By courtesy of the "Scientific American."

THE "PREUSSEN," THE WORLD'S LARGEST SAILING VESSEL.

THE STEAM TURBINE.

Speed as well as size has received the attention of the shipbuilder. In England, one of the interesting departures from ordinary methods is the use of a steam tur-



THE MINNESOTA. LARGEST MERCHANDISE VESSEL EVER BUILT IN AMERICA.

bine in the King Edward VII., which was the first passenger steamer thus equipped. This departure seems destined to revolutionize marine transportation.

THE VIPER AND COBRA.

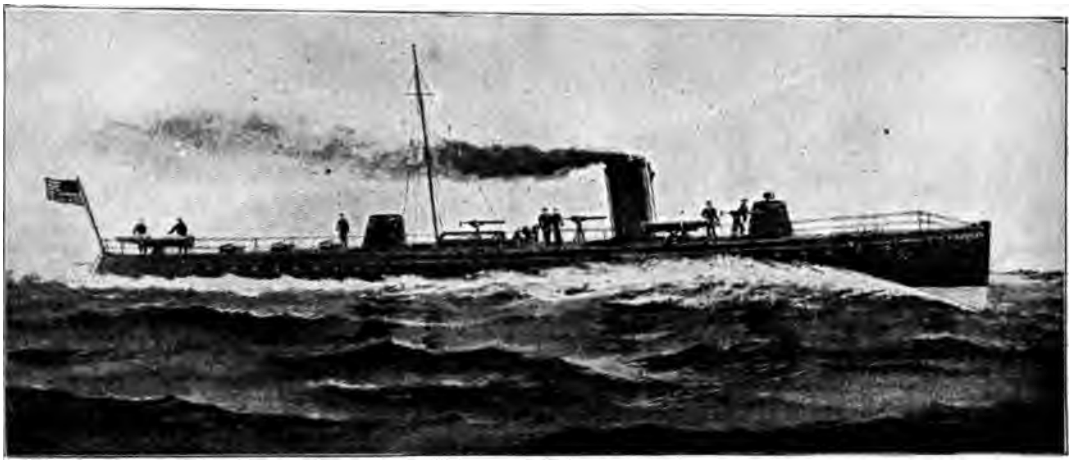
As far back as 1894, the turbine showed great success in the two torpedo boats, Viper and Cobra. The former reached a speed of thirty-seven knots an hour. The King Edward VII. has made an average speed of over twenty knots. The weight of her machinery is sixty-six tons, which is about half as much as is required to develop equal horse-power in the paddle-wheel steamer. There is almost an entire absence of throbbing and pounding.

THE ARROW.

The Arrow, a vessel recently built for Charles R. Flint, of New York, has recently attained a speed of nearly fifty miles an hour. Her description is as follows: Length, 130 feet; beam, 12 feet 6 inches; displacement, 66 tons; horse-power, 4,000. She can be stripped and converted into a torpedo boat at forty-eight hours' notice.

THE MINNESOTA. LARGEST VESSEL EVER BUILT IN AMERICA.

The "Minnesota," cargo and passenger ship, designed for the Pacific trade between Seat-



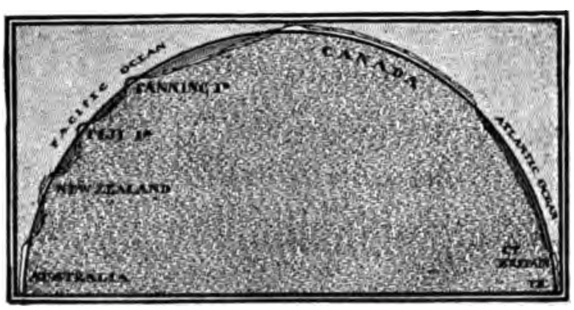
THE ARROW—THE FASTEST STEAM CRAFT AFLOAT.

tle, Honolulu, and Yokohama, is the largest vessel ever built in America.

In this vessel, the Eastern Shipbuilding Company, of New London, Connecticut, has embodied all the features of the great White Star liner, "Celtic." The Minnesota is of imposing appearance and is thus described: Length, 630 feet; depth, 56 feet; breadth, 76 feet 6 inches; displacement, 37,000 tons. Her engines are of 10,000 horse-power, supplied by steam from sixteen Niclausse water-tube boilers, which will drive the ship at a speed of fourteen knots per hour.

While the Minnesota is designed primarily for freight, she will carry 172 first cabin passengers, 110 second cabin, 68 third cabin and 2,424 steerage passengers or troops, in addition to a crew of 250. The speed is fourteen knots and it is expected to average twelve knots with the heaviest cargoes and in the worst weather.

In completeness of electric service, of cold storage and refrigerator plant, of laundry service, ventilation plant and life-saving appliances, the Minnesota is the most modern and up-to-date vessel yet launched. The dining saloons, the cabin, library and women's boudoirs, the staterooms and toilet rooms are models of the latest discoveries in their respective lines. The "Minnesota" originated with J. J. Hill.



A CABLE THAT GIRDLES HALF THE GLOBE.

The linking-up of the new cable at Suva in the Fiji Islands makes one continuous British telegraph wire from Britain to Australia.

EGG CANDLING BY MACHINERY

Egg candling by machinery is one of the modern wonders of the poultry world. In ancient times eggs were held up to the sun or some strong light, and thereby tested as to their freshness. This process was considered very slow and far from satisfactory.

PACKING 27,080 EGGS PER HOUR,
At the Chicago Stock Yards.

A few years ago, when the big packers of the country began to deal in eggs and poultry, the necessity of an egg candling machine dawned upon the more progressive dealers. Then a systematic appeal was made to inventors in all parts of the world to produce some kind of a machine that would be rapid and would prove a success.

In this, several Englishmen participated, but it was left for a "down-east" Yankee to devise a machine that would candle eggs, and do it with such rapidity that it was found necessary to have five women to remove the eggs after having passed through the inspection house. In 1892, a machine of this kind was put into one of the big packing houses at the Chicago stock yards, and within a week it was running so smoothly that 27,080 eggs were candled in an hour's time.

The egg candler consists of a box or house, eight feet square and ten feet high. Through this runs a shallow trough. Inside the house are a set of rollers, which work in screw fashion, and over these rollers the eggs pass while being inspected. Underneath the rollers is a set of powerful electric arc lights. Two women stand at the feeding end of the candler, and pour eggs upon an endless belt that carries them in upon the rollers. As they roll along the inspector picks out the bad and broken eggs. The former he consigns to the "fertilizer" tank, and the latter, to an upper set of rollers which carries them out to a woman in waiting, who places them in a box marked "broken," or, if they are badly cracked, breaks them into a can.

The eggs that are broken into the can are stirred together, and when the can is filled, it is conveyed to the cooler, where the contents are frozen and, later, sold to bakeries. The good eggs are placed in cases and put into cold storage. It is not an infrequent thing for the packers to have 15,000,000 eggs in storage.

EVOLVING NEW KINDS OF WHEAT

In the rapid advance of scientific methods of farming, not the least important result is that obtained in breeding new kinds of grain suitable to the peculiarities of soil in the different sections of the country. Particular study in this line has been made by our agricultural colleges, and marvelous are some of the new species developed by careful and persistent experiments.

The stronghold of these experiments is the Minnesota State Experiment Station associated with the agricultural school of the University of Minnesota. From the results of the efforts made here, a revolution in the production of wheat is promised, if, in fact, it has not already been achieved.

The purpose of the experiments was to develop new breeds of wheat. The new kinds of grain thus produced show a power of increase, both in yield and quality. By a process of breeding and careful selection a product has been evolved which not only stands every test of successfully withstanding climatic severity, but also shows the presence of every essential food quality.

No longer is this development in the merely experimental stage. The new breeds have stood the test also of the farm, and the result will doubtless be a bettering of wheat harvesting, not only near the section where the experiments were carried on, but in the wheat area of the whole world; it will also result in the addition of great wealth to the farming districts. Millions of dollars are being added to the value of single sections of the wheat raising country, and a practical denial is given to a statement that ere long, there would not be enough wheat for the increased population of the world.

The work at the Minnesota station began something over ten years ago. The purpose was not only to secure new breeds of superior wheat, but to secure enough of this superior breed to enable the farmers to profit by the practical use of it.

The process followed necessitated removing the pollen from the flower of one grade of wheat to the stigma of the flower of another. Two breeds of good character are

selected in the experiments, one for the father, the other for the mother of the new breed. About four o'clock in the morning, when the florets of the wheat open, the operation is performed, and then the head of the wheat is enveloped in a sack of tissue paper, in order to keep out insects. It may be that some of the good qualities of one wheat are mingled with the bad qualities of another, when the harvest of the new breeds is garnered. Painstaking work, however, has finally resulted in new and much stronger varieties, and now that they have been secured, they will go on reproducing themselves, to the benefit of mankind.

In the process of selection, only the hardiest grades were selected for new breeding. The best start in life is accorded the new wheat, and only the best of the new grades are kept. Some kinds were found to be too heavy and rank in growth, thus tending to "lodging" or falling during periods of rain and much moisture. Others were found to be especially susceptible to wheat diseases. Still others showed a deficiency in food quality. In all, over 500 new grades were thrown out in the early tests, and less than a dozen were retained for the practical farm tests.

Something of the practical results of the experiments may be learned from the prolific qualities shown. In tests where the new breeds were grown side by side with old wheat, there was an increase in some cases of from eight to twelve bushels an acre. The new wheat that has been best tested so far, is called Minnesota No. 163, and shows an average yield of 42.7 bushels per acre. Of eight grades tested in small experiments, none averaged less than 19.5 bushels per acre, while the average of six breeds was 27 bushels, and the average of all averages showed 28.1 bushels.

Tests made comparing the new breeds with Fife wheat—one of the old standard wheats—showed an increase of four and one-half bushels, and an increase of one and one-half bushels an acre was made over all wheats compared. From these tests it is concluded that the new breeds will excel the old by at least two bushels, although, when it is considered that under ordinary conditions the old breeds develop only about thirteen to fifteen bushels an acre, this seems too small. And yet, when it is further considered that in the Dakotas and Minnesota about 15,000,000 acres are annually under cultivation this increase means an additional yield of 30,000,000 bushels. At 75 cents a bushel, the annual increase in wealth to the farmers of three states only should be about $22,500,000. When all these things are considered, it may be readily seen that humanity is a great gainer; for, not only is the greatest source of food supply made more hardy, more certain and more safe, but the wealth of the world is certain shortly to be greatly enhanced.

If this proportion of increased production be applied to the entire wheat-growing area of the country, the results to agriculturists would be of almost incalculable benefit.

But the enhancement of the prosperity of the farmer through this multiplication of the profits of his labor is not the only cause for congratulation over the success of these experiments. As bread is verily the staff of life, and constitutes almost the main dependence of millions of lowly families, whose lot is ever on the verge of want, whatever tends to maintain the supply of this great staple up to the utmost possible demand, at rates within the means of needy multitudes, will be hailed as a boon.

THE TWENTIETH CENTURY DAILY NEWSPAPER

HOW IT IS MADE UP AND SENT OUT.

Among the forces that have worked for progress in civilization, none is of greater importance, and yet is more misunderstood, than the modern newspaper. In point of both literary and mechanical perfection, the American daily paper stands supreme. Not only does the metropolitan paper of the United States excel its foreign contemporaries in both bulk and circulation, but it is almost entirely free from the blot of subsidy which smirches so many papers in Europe. Being untrammeled by any but self-imposed checks or hindrances, the American daily is the best exponent of the freedom of the press, and in its fearless attitude in all matters, serves the public with a unique and honest loyalty.

While every one is acquainted to a great extent with the salient points of American journalism as exemplified in any one of the many thousand papers constantly read in the American household, there is an aspect to the progress made in the last few years which to the average mind is most marvelous. This is that feature of the work which enables a journal to gather the news of the whole world, and to deliver it in printed form within a few hours of the date of the matter chronicled, to thousands upon thousands of subscribers in their homes, many of them hundreds of miles away. To the unprofessional mind, the work of this public servant seems lighted by a halo of mystery. There is, in truth, much about the up-to-date newspaper plant to mystify, but let us here unravel the mystery.

For convenience a business-like newspaper plant is divided into a number of departments, usually as follows: editorial, circulation, advertising, general business, and mechanical. Each of these divisions is in charge of a superintendent, whose duty it is to see that the work of his department goes on with the utmost precision and accuracy. These superintendents in turn confer with each other or are instructed by a general manager, as to that ultimate combination of their forces which produces a perfect newspaper. About 600 people constitute the working force of the metropolitan daily. From start to finish, from office boy to publisher, speed is a requisite. This may be understood when it is known that

BENJAMIN FRANKLIN AND HIS PRINTING PRESS.

from the moment the gathering of a day's news begins, until it is printed by the half million copies, and is speeding on its way, by fast mail, to be read by millions, but from six to twelve hours elapse. Let us note the process by which news is picked up and made of commercial value.

THE VARIOUS STAFFS.

At the head of the editorial department stands the managing editor, who is responsible for his department to the editor-in-chief and publisher, and to him are responsible the numerous city, associate and sub-editors, and reporters. In general, each of the staffs of a paper is made up of over twenty-five men. Those whose work it is to issue the evening editions come to work before seven o'clock in the morning, relieving men already on duty. Until the last regular evening edition is printed and away, these men are on duty. Overlapping them and coming to work about noon, is the staff of men who issue the following morning's edition. While following upon this other staff, comes the third force near midnight, working until relieved by the next day's shift.

Each of these staffs is divided in such a manner as most effectually to "cover" the news of the world, and to write and prepare all reading matter, aside from advertisements, that appear in the paper. In order to do this, a number of men are assigned to take care of all the news in certain "departments," such as finance, music, the drama, railroads, politics, leading editorials, the funny column, etc. The routine news of the days is gathered in two ways—that from out of town by mail or telegraph and from special news bureaus and correspondents, and the city news, through a corps of local reporters. The former work is under the care generally of the telegraph editor, and the latter, under the city editor.

Telegraph news, while not always as interesting and valuable as important local news, yet plays a great part in every paper and relatively costs as much, and frequently more, than city news. The telegraph editor is assisted by several experienced men called copy readers. Since practically all the matter in the telegraph department comes to hand in written form, the duty of these men is principally that of reading it to see that the matter conforms to the general policy of the paper, and to correct any superficial errors. These men also write the large headings for the telegraph news.

While the work of editing telegraph "copy" in a newspaper office is something of an easy task, the gathering of this news has reached such a stage of perfection that it may be truly called marvelous. In the main most papers rely upon some news bureau for their out-of-town service. Large papers, however, retain correspondents in many cities (frequently employes of other papers), who gather special items not carried by the bureaus. These correspondents are in constant touch with the paper by mail and telegraph, and aside from a few representatives in very important cities, are paid according to the amount of news printed.

THE ASSOCIATED PRESS.

So intricate is the business of a well equipped news bureau, that it will be worth while briefly to describe the most important one of the kind, The Associated Press. This association is a corporation, not for profit, and consists of a mutual organization of over 600 of the most influential

papers of the country. Its object is to gather the news of the whole world, and to serve its associated members therewith. In every large city in the world this organization is represented by an experienced newspaper man, whose duty it is to gather news worthy of national notice in the United States. Leased telegraph wire is spread across the country in every direction, connecting the principal offices of this organization. Special service is secured from the world's greatest cables. In times of storm, when wires are damaged, the first ones repaired are put in the service of this company. Every effort is made to circumvent time. The service of foreign news bureaus is secured to amplify the work of special correspondence. Thus if a queen dies at Windsor, a king is crowned at London, a new dictator assumes power in one of the Latin-American states, or a tribe of African savages swoops down upon a band of explorers, the news is flashed almost instantly to every newspaper in the association and shortly after appears in printed form for the edification of newspaper subscribers. In smaller cities this news is taken directly from the telegraph instrument by an expert operator, or is served to the newspaper as messages from one of the telegraph companies. In the large cities, where a number of papers are served, the association employs a staff large enough to supply each paper with type-written manuscript. This is usually sent by pneumatic tubes which run underground long distances, and connect the several newspaper offices.

LOCAL NEWS AND THE REPORTERS.

The gathering of local news devolves upon the city editor and his corps of reporters. By a simple method of keeping clippings of all notices of important events, to develop, and by carefully tracing down every clew that may lead to news, the gathering of actual happenings of importance in the way of news is reduced almost to clockwork precision. Every man connected with a newspaper is always on the alert for news. The reporters are assigned regularly to certain districts to gather whatever turns up in them. Police reporters are detailed to watch all accidents, crimes, fires, etc., that are reported at police stations. The society department keeps close touch with events of social importance. As in the telegraph news department, there is also a city news bureau in every large city. This bureau has a large corps of men covering routine work, such as courts, police stations, city, county and state offices, etc. Thus it is that all papers print, practically, all the news worth printing. Of course, a certain paper, through the large acquaintance of its best men, may now and then secure exclusive news, called a "scoop," but in the long run, one paper prints as many exclusive items as another.

ESSENTIAL QUALITIES IN THE NEWSPAPER MAN.

Of the newspaper man, himself, it may be said that he is essentially a worker. All sorts of ideas and things are material for him to work upon. His occupation is to him the breath of life.

Above all, to succeed, this man must use his every opportunity to the best advantage. To the person who knows nothing of his labors, he appears simply as the genial critic, editor or reporter, with something of a halo about him, denoting that he lives a life free from care and always to be envied. While there are phases of this sort in the

life of the newspaper writer, they are exceptional, and the true basis upon which such men build their success is strenuous exertion. From beginning to end of his work day, he must be constantly on the alert for information that may develop into a "story" for his "sheet." True, nowadays, the management of a great newspaper is so methodical that a great deal of the work of the reporter or editor is laid out for him by men in higher authority. Yet, every moment there is some call upon even the youngest of the craft to exercise judgment and caution and a discrimination that is not often necessary in other callings.

To the powers that be in the realms of news, there is no such word as fail. If a rival journal has a piece of news exclusively, some one is responsible for its absence from your paper. It does not matter how many exclusive "stories" a man may deliver, how many "scoops" he may secure for his paper, if he is beaten, they count for naught. If he cannot do as well always as men on rival papers, he will lose his position.

And, further, the efficient newspaper worker must have perception and adaptability to handle a piece of news when he hears it. The well-equipped man is he who can write intelligently of a technical legal case as readily as of a midnight fire, of things financial with as much facility as of social matter. He must be able to grasp instantly the essential details of any occurrence that may be of value as news. Such a man has a smattering of legal knowledge, of the fine arts, of medicine, to say nothing of the intricate mazes of politics and political jobbery, of the wickedness of the under world and a hundred and one other phases of human action.

REPORTING A FIRE.

The actual course of a news story from the moment of the happening to the time it appears in print is something of a dramatic affair. If it is a big fire, when the fire alarm sounds on the special bell in the newspaper office, the city editor locates the conflagration and dispatches from one to ten men, including artists and photographers, to the scene. Generally these work under the direction of one man. Every detail possible is secured. The "office" is informed every few moments by telephone how the fire is progressing, and whether people are being burned or saved, etc. If the hour is late and occasions extreme haste, one man will telephone a connected story of the event to his office, and there it is amplified by an inside man. Pictures are taken and hurried back to headquarters for engraving.

"SCOOP" ON A SUICIDE.

If the story, instead of being common to other papers, is to appear exclusively in one paper, great secrecy is maintained. For instance, the writer overhears in a popular Chicago café, shortly after midnight, a conversation between two army officers about the suicide of a well-known military man at a fashionable hotel, on the eve of his wedding. Such news is "hot," and if true, would possibly be exclusive. Every effort is made to obtain the facts without arousing suspicion, and the next morning rival newspapers are filled with envy over a great "scoop."

THE CITY EDITOR.

After the "copy" of a newspaper "story" has been prepared by the reporter it generally passes through the hands of the city editor or one of his principal assistants,

who judges of its news value in order to decide how important a position it shall hold in the printed paper.

THE COPY READER AND PROOFREADER.

From him it is turned over to the copy readers, whose duty it is to correct all errors due to haste—for haste is the one great requisite in newspaper work. They also write the large headings and intersperse sub-headings throughout the article. From the copy readers' desk the story travels to the typesetter, thence to the proofreader and back, in the shape of printed proof, to the editors and copy readers, who watch for errors which the proofreader may have overlooked. The course of the passage of the story through other processes will be found farther on, in the description of the other departments of the newspaper plant.

THE COMPOSING ROOM.

The composing room is the place where the typesetter, busy amid the hum of intricate machinery, puts into print the articles prepared by the advertising and editorial departments. The work done in setting the big display advertisements, which bring wealth to a newspaper, is done in much the same manner that typesetting was done years ago—by hand. This also is the case with most of the big headings of news articles. The setting of small advertisements and of the body of the paper is done, however, by machinery.

THE LINOTYPE.

The linotype machine which, as its name indicates, sets a line of type by machinery is one of the greatest inventions of the age. Its basic features were developed by Mergenthaler. This machine does the work of many men, and with such speed and accuracy that it is worthy of special notice. It has the appearance of a gigantic typewriter, and has for its main principle the automatic dropping of tiny brass molds for certain letters and figures, when certain keys are depressed. These molds are called matrices, and when a line of them has been set, they are flooded by a combination of molten lead and zinc, thus forming a line of type.

The linotype operator sits before his keyboard with his "copy" in front of him. With deft fingers he gently depresses the keys until he hears the warning of a bell, which tells him a line of matrices has been set. Then he presses on a lever at his side, the line is cast in metal, and a great arm reaches down, picks up the line of matrices and places them at the top of the machine for distribution. And here comes in one of the most delicate functions of the machine. Each matrix or mold, besides bearing the imprint of a certain character, is grooved much in the same manner as is a Yale key. Each of these grooves and their combination signifies the character the matrix represents. At the top of the machine is a distributing bar, which resembles a constantly revolving screw. After the line of type has been molded and the arm has delivered the line of matrices at the top of the machine, this distributing bar seizes them. They travel along on the screw until the grooves of the various matrices find their mates at little openings above the magazines which hold the matrices before use. Thus as each matrix is sifted from its mates by means of the grooves, it finds its way into the magazine for that letter, and is once more in readiness to be released upon the pressure of its particular key.

A FORCE OF LINOTYPE OPERATORS ENGAGED IN THEIR WORK.

After an article or advertisement has been set up in type, it is hurried over to the "form" or "make-up" table, where it is assigned its particular place in the page of type, is locked up in a great chase, and is sent to be stereotyped preparatory to going on the press.

STEREOTYPING.

The stereotype department is the outcome of the necessity for rapid printing on cylinder presses. When the old-style hand or flat presses are used, type is frequently used just as it is set. Where newspapers, however, are turned out by the half million copies daily, another method is necessary. As soon as the form of a page of type is delivered to the stereotype department, it is the duty of the workers there to cast a duplicate of it in type metal, but in the shape of a half cylinder. This shape is needed in order to fit on the cylinder rollers of the steam printing presses.

The method of making this plate necessitates first the making of a mold which can be bent. This is done by taking an impression of the form in something that resembles papier maché. Thin layers of prepared tissue paper, with a sprinkling of a floury preparation between them, are placed on the page of type. Then the whole form is run through heavy steam rollers. This presses the paper well down into all the indentations of the type or illustrations in the page. In turn, this is run into a steam chest, where, in a very short time, the preparation is baked stiff. When the mold is removed, it resembles heavy pasteboard, and is the exact facsimile of the page of type. This matrix can be bent readily and placed within a cylindrical chamber, when it is at once flooded with type metal. Almost before the metal is cool enough to have congealed, the stereotypers have opened the molding chamber and have placed the semi-cylinder or plate upon an apparatus where all the imperfections may be chiseled out and the rough edges planed off. This work is so rapid that in a well-ordered department the plates are delivered hot to the press room. Different plants use somewhat different methods, some sending the plates by elevators down to the press room, and some of them being located in the basement of the building, adjoining the press room, receive the type forms from the composing room, and send them back by elevator.

THE PRESS ROOM.

Everything so far in the passage of the newspaper story from reporter to pressman has worked on rush orders and on schedule time. This is necessitated because the presses must be started at just the same moment every day. Great newspapers have subscription lists containing names of readers hundreds of miles from the city of printing. The papers to these readers must be sent over certain routes by fast mail trains, and to miss a train means that a rival newspaper will be read in many a town the next day, to the exclusion of its competitor. Thus in the editorial room an hour is set, a "dead line," so to speak, after which nothing can be written which will appear in regular editions of the paper. So is it with the composing room. Certain pages must "go down" to the stereotype room at certain specified times. The whole process from writer to press in rush times is frequently less than half an hour, but this is not the constant speed of the plant.

THE PRESSES.

Now, when the stereotyped plates are received at the press room the bustle begins in the great department of steam, machinery and noise. With almost lightning-like rapidity, the plates are clamped two on a cylinder of a press. The size of the paper to be printed regulates the speed of the press, as well as the number of cylinders to be used. Thus a great 20 or 24-page paper, coming from one press, means a dozen cylinders whirling.

Before the cylinders have been clamped into place, orders have been issued as to the size of the paper. Great rolls of paper, on spindles like gigantic spools, have been rolled into place on traveling cranes, and grouped about the presses, ready for immediate use. Some of them are already in place in the presses, like several spools of thread in a sewing machine. When the plates are all in order a signal is given, every man gets out of the way of the danger of crushed arms or legs in the immense rollers, and the steam is turned on by a great lever.

FEEDING PAPER FROM GREAT ROLLS.

The paper is fed from the rolls on the spindles down between the revolving cylinders and smooth steel rolls. This causes the impression, and prints the newspaper. In guiding the paper through the rolls cloth tapes are necessary to prevent the paper from slipping. After the paper is printed it passes over certain knives, paste brushes and folders, which sever the paper from the continuous roll, paste the leaves in position, when this is necessary, and fold the paper ready for the street. All this is done so rapidly that it can be counted only by machinery. Papers with only a few pages can be run out, ready for delivery, at the astounding rate of 48,000 an hour. An order was recently placed with R. Hoe & Co. for seven double octuple presses, equal to 28 quadruple machines, or 112 ordinary single-roll presses. These will print on eight rolls of paper the width of four newspaper pages, and when running to the full capacity the output from each will be equivalent to 200,000 eight-page sheets per hour. Eighteen hundred feet of printed webs of paper will pass through one of these machines every minute. The 16-plate cylinders each carry eight stereotyped plates, and 64 pages can be printed at will, in black or in colors.

FROM THE PRESS ROOM TO THE READER.

From the press room to the reader is comparatively as rapid as the other operations of the plant. Bundles, of several hundred at a time, are seized from the presses and hurried by automatic devices—little traveling elevators and cars—to the delivery room. Here crowds of newsboys and delivery men are eager to speed them on their way. Those papers that are to be read in the city of publication are hurried by fast wagons, elevated trains and street cars to every section, business or residential, of the great metropolis. On the morning newspaper this is done while the greater portion of the town still sleeps. The papers that are to be sent to suburban villages and distant towns take another course. The circulation department has already had prepared lists of all readers and dealers who get the paper. These lists indicate the post office address of subscribers, number of papers subscribed for and date of expiration of subscription. Long before the

paper is printed, expert "mailers" have deftly pasted the little yellow slips from these lists on the wrappers in which the papers are to be mailed. This operation is done by means of a little machine called the "mailer," which can be used by one hand and made to paste the slips very quickly. When the papers are received from the press room, the workmen in the mailing room seize bundles of them, count them out accurately and swiftly, wrap them, bundle them into United States mail bags, and hurry them off in wagons to catch the fast mail trains.

MAKING THE ILLUSTRATIONS.

One of the great adjuncts to the latter-day journal is its illustrative features. A paper that does not print pictures, and many of them, is playing, as a rule, a losing game. This necessitates a photographic art and an engraving department. When an artist or photographer returns from an assignment to secure a certain picture for the columns of the paper, great speed is generally required. If it is a sketch, the artist has been working out his idea on the way to the office, in his cab or in the street car. In his studio, he rapidly makes the drawing of fire, wreck or person. Fine white Bristol board is used, and India ink leaves the lines black, for the engraver. The photographer, in case a photograph is to be used, has hurriedly developed his plate, and from it has had a picture printed on sensitized paper. Perhaps the artist must retouch this picture or redraw its fainter lines in ink. This is hurriedly done and the results are taken to the engraver. Here either of two methods may be used. One is the half-tone process, which is used principally for photographs of persons, and the other is the zinc-line etching for black and white drawings, sketched by artists.

In the latter method a "wet-plate" photograph is made of the artist's work, possibly of several sketches at once. This wet-plate photograph is much like the ordinary dry plate negative of the snap-shot photograph camera, excepting that the gelatine with which the glass is coated is yet wet when the picture is exposed. This gelatine is developed by ordinary photographic methods. Then the gelatine of several pictures is removed from the first glass used and pasted on heavy plate glass, a number of pictures in a group. After these have been dried hard by heat from a gas stove, this plate of pictures is enclosed in a frame with a sheet of zinc, sensitized after the manner of photographic paper. The plate is now exposed to the glare of an arc light. The sensitized zinc receives the impression from the light and negative, and after it has been developed and eaten down by acids, and by machinery which routs out imperfections, we have engravings of the pictures first drawn or photographed, now ready for mounting on metal bases for the printed page. In half-tone work, the process is similar, but when the photographs or artist's drawings are being photographed, fine screens intervene between the plate and the pictures, in order to give the mellowed shadings of the finer engravings.

Besides the departments already described there are the distinctively business offices, without which no paper can thrive. The circulation department canvasses, schemes and plots to secure a large number of readers for the paper. All sorts of devices are made use of. Prizes are offered, books and pictures are given away,

and great quantities of advertising matter are sent out by hand and by mail. Men are paid fabulous salaries for ideas to swell the circulation lists.

THE ADVERTISING DEPARTMENT THE ONLY SOURCE OF PROFIT.

Of equal importance is the advertising department, which secures the large and small advertisements that are printed in all great papers, and from which the publishers obtain their profits, or, at least, the means to operate the newspaper; for, be it known, few newspapers make great profits. In fact, many are run at a loss, to support political parties, or to give power to some great capitalist, or, possibly, even as playthings for rich people. The advertising department maintains a corps of solicitors and clerks to gain business for the paper. Argument is constantly used as to the great circulation of this particular journal. Want advertisements, such as "servants" wanted, or other similar business or domestic wants, have become such a great feature in the advertising department of the paper that, in large cities, branch telephone offices are established all over town to facilitate their collection and transmission to headquarters. The advertisements of the great department stores frequently serve as the support of a newspaper. Big stores frequently use $25,000 worth of advertising in a single paper in a year.

The expenses of running a newspaper plant are very great. It should be known that hardly any large paper ever makes any money from its subscription list. The paper on which the journal is printed nearly always costs more than the printed papers bring in return. It is the advertising which counts, and the circulation list counts in turn only as it can give greater publicity to the advertising and thus serve as the means of securing much advertising matter and high advertising rates. It is figured, generally, that if a plant can deliver its publication without losing money on its selling-price, it is in excellent condition. This, of course, is seldom the case with great Sunday papers, with their 50 and 60 pages of expensively-written and illustrated articles.

FOUR O'CLOCK A. M.—NEWSBOYS WAITING FOR THE DAILY PAPERS.

THE "SOO'S" GREAT POWER CANAL

The largest power canal in the world is at Sault Ste. Marie, Michigan, and is used for the operation of gigantic iron industries. It provides for the reduction of 20,000,000 tons of iron ore at the very door of the mines.

In the water power development at the "Soo" is realized the utilization of the natural force inherent in the waters of Lake Superior. There they flow out over a sandstone ledge about a half mile long, half a mile wide, with a fall of 20 feet.

LAKE SUPERIOR GIVES THE "SOO" CANAL 200,000 HORSE POWER.

Lake Superior covers an area of about 36,000 square miles and is fed from a water-shed many times greater, the Sault Rapids being its only outlet. The quantity of the water discharged fluctuates, with the varying conditions of precipitation and evaporation, from about 3,600,000 to 7,000,000 cubic feet per minute, which, rushing over the Sault Rapids, represents an equivalent of from 130,000 to 260,000 horse power.

Just south of the western entrance to the United States Ship Canal lies the intake to the power canal, about 950 feet wide. The total distance of the constructed waterway is about 13,000 feet, the width from the expanded intake entrance gradually lessening to 200 feet, excavated to such a level that, when the full maximum power of the works is being used, water will flow at a uniform depth of 25 feet.

CONSTRUCTION OF THE CANAL.

The entire construction of the canal has been carried on with a view to the greatest efficiency in delivering the energy of the water, and it is everlasting in durability. Throughout the intake the sides of the canal are retained by timber cribs securely placed and framed, rendering the sides of the waterway smooth and permanent. The timber construction is continued to a point just below the water, and covered with masonry construction. The canal sides through the rock formation are channeled out vertically, its walls and bed being smooth. All defects in stratification are remedied by masonry construction, of which the embankments also consist.

The flow area of the canal differs with its different sections. The water will flow 25 feet deep through the entire canal, and will attain a velocity of four and a half miles an hour. This will deliver, approximately, 30,000 cubic feet of water every second to the turbines.

The conduit terminates at the power house, which performs the function of a dam, in which water wheels are so placed that the only escape for the water to the lower level is through them.

The equipment consists of hydraulic and electric apparatus. Each hydraulic unit is composed of four new 33-inch American turbines, arranged in two parts on one shaft. Each pair is housed in one case and discharges into one draught tube. The installation is of the horizontal, tandem type, the shaft and operating rigging penetrating the steel-plate bulkhead and coming out on the dynamo floor side. Each hydraulic unit, under normal conditions, equals 568 horse-power.

Involved in the construction of this canal were 1,250,000 cubic yards of rock and 3,000,000 cubic yards of sand excavated and dredged. This material was all utilized

in reclaiming land under water, which is the property of the operating company. The material used consisted of 3,500,000 lineal feet of piles, 170,000 tons of concrete and monolithic blocks, 90,000 cubic yards of sandstone masonry, 32,000 square yards of dry sandstone pavement, 260,000 barrels of cement, used in all masonry, and 24,000 square feet of iron roofing.

LARGE TRACT OF NEW LAND MADE THROUGH EXCAVATION.

Two hundred and sixty acres of land were reclaimed during the construction, being filled in with the excavated material; 2,800 lineal feet of navigation docks were built; 22 miles of rails were laid and operated. The excavation was carried on with an equipment of eight steam shovels, 24 locomotives and 350 four-yard dump-cars, all work being carried on night and day, excepting Sundays.

The approximate cost of the entire right of way, canal, power-house, equipment, docks and appurtenant works, developing 57,000 horse power, is about $4,000,000.

THE WORLD'S STUPENDOUS GRANARY

Fifteen million barrels of flour is the annual output of the world's greatest granary, at Minneapolis. For some time this city of the Northwest has been recognized as the largest primary wheat market of the world, and also the greatest milling center.

Thousands of persons make annual trips to Minneapolis to see the great mills, and observe the process by which several trainloads of wheat are turned into flour in one day. But the methods of flour making have undergone so many radical changes within the past few years that men who were once experts in the business would now be novices.

GREAT INCREASE IN CAPACITY OF FLOURING MILLS.

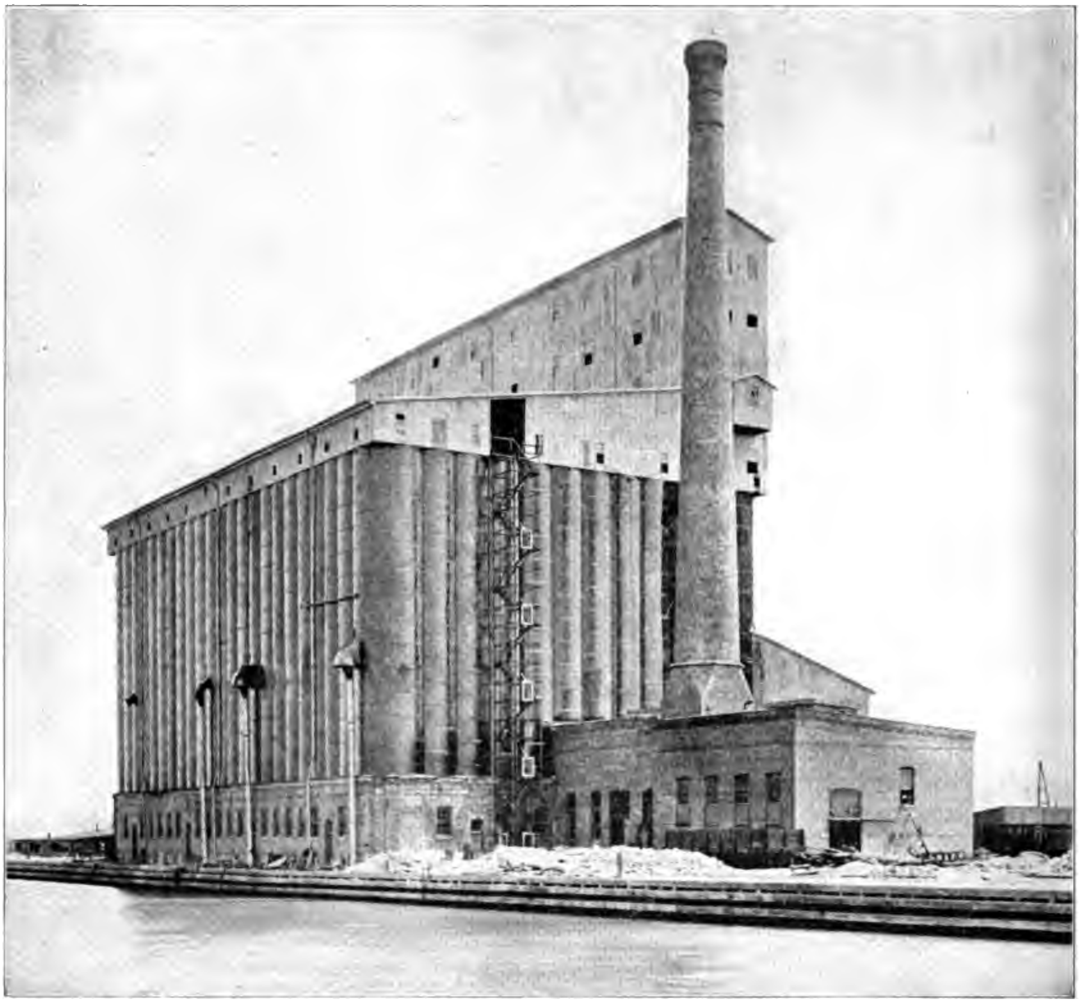
The number of flouring mills in Minneapolis is no greater than it was 20 years ago, but the present annual output of 15,-

WHEAT FIELD, DAKOTA.

000,000 barrels exceeds that of 20 years ago by more than 650 per cent, and this in the face of the fact that some of the larger plants manufacture, in addition to their flour product, immense quantities of the different kinds of breakfast cereals now so commonly used. The gain in capacity is due to the fact that most of the mills have been enlarged from time to time and equipped with the very best modern machinery.

LARGEST FLOUR MILL IN THE WORLD.

As an illustration, the Pillsbury mill was constructed in 1880 with a daily capacity of 5,000 barrels, but it has been improved until its capacity is now 14,000 barrels. This is the largest flour mill in the world.

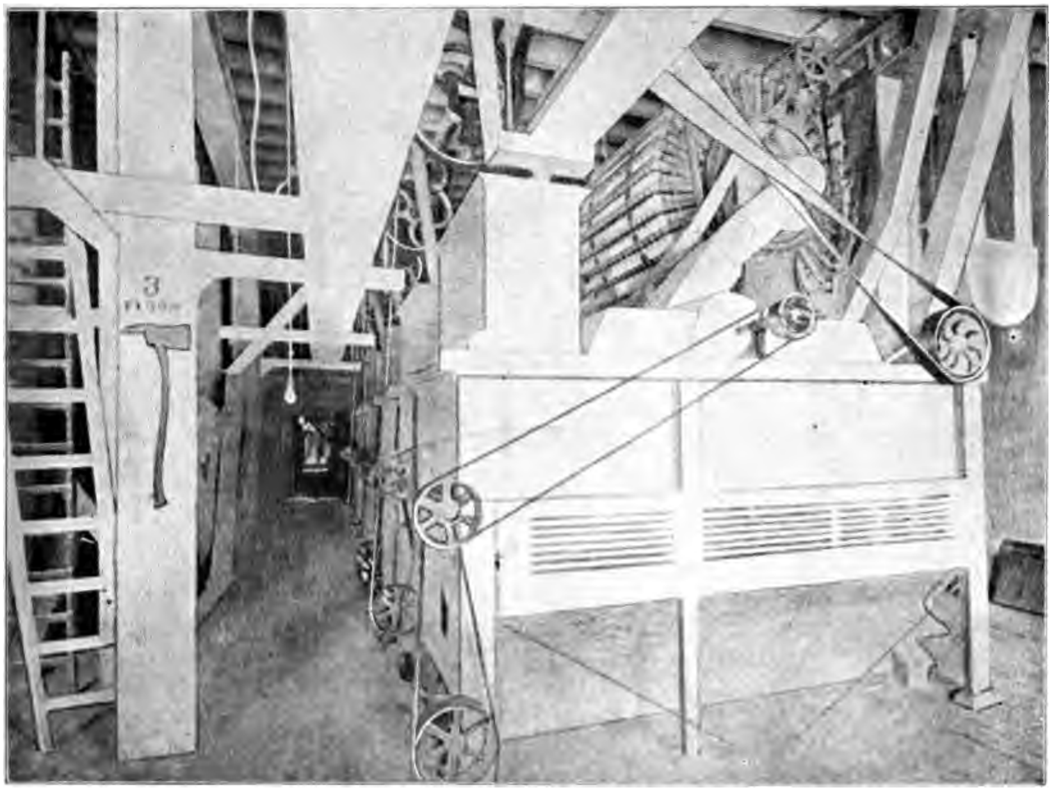


A MAMMOTH GRAIN ELEVATOR—"THE GREAT NORTHERN," AT DULUTH.

MECHANICAL PROCESSES OF A GREAT FLOUR MILL.

The flour mills of the present are a wonderful triumph of scientific industry, and when in full operation one of them seems

almost a thing of life. The wheat is shoveled by machinery from the car into a large pit, from which it is taken into the endless machinery of the mill. It is then hurried on, this way and that, through secret passages, from one side of the big mill to the other, now up, now down, through this machine and that, until finally every kernel is divided into as many component parts as the processes number, and each part drops into its own receptacle. It has been forced through all these by the mill's own machinery, without having been touched by human hands or seen by human eyes. No one is watching to see if it takes the proper course, or if any part of the machinery does its work; a lever is pulled which conducts a portion of the Mississippi upon a big wheel, and all the intricate machinery in the giant mill responds with a harmony that seems almost human.



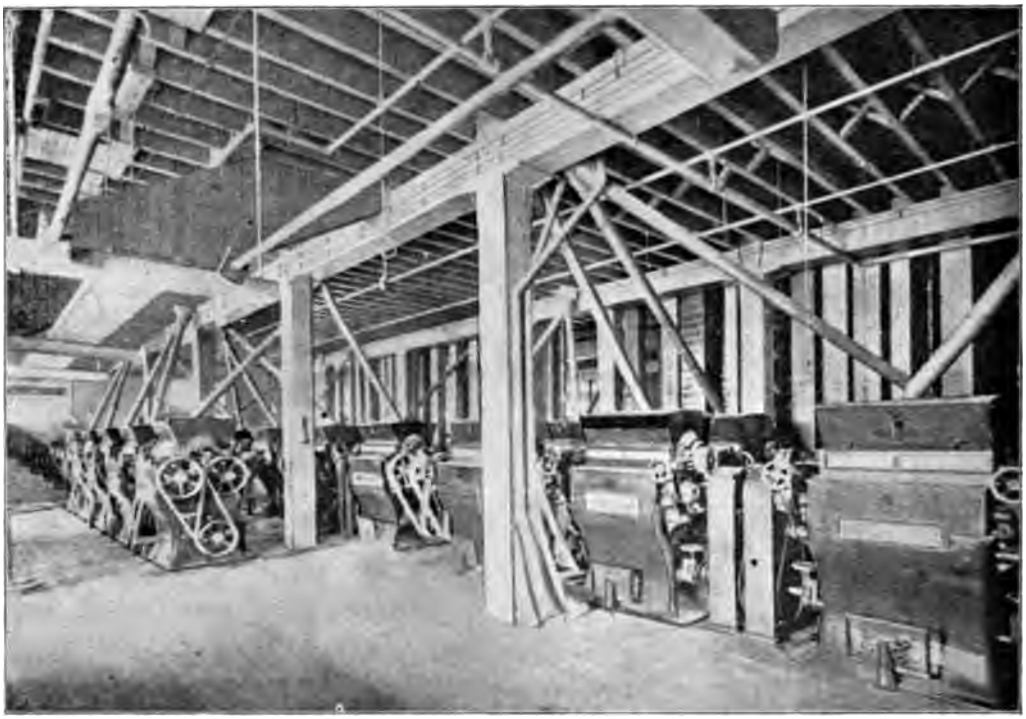
DUST COLLECTORS AND PURIFIERS, PILLSBURY "A" MILL.

DECREASE IN PRICE OF FLOUR.

Incidentally it may be mentioned that while the mills have been increasing their capacity and improving their processes the price of the product has been steadily decreasing. In 1880 the average profit on a barrel of flour was about 75 cents, while now the millers think themselves fortunate when they figure up their profits and find that about 20 cents is realized after all expenses have been paid.

It must not be inferred from this that

the business of milling has reached a crisis, or that the meager profits on a barrel of flour, as compared with those of the early days, have affected the milling industry. The price of flour has been reduced through natural causes, but the reduction has been, perhaps, more than offset by the increased capacity of the mills through the introduction of modern machinery. The lucrativeness of all the large manufacturing industries to-day depends upon the great volume of the output rather than upon the large percentages of profit.



GRINDING FLOUR, PILLSBURY "A" MILL.

THE NEW MONSTER ELEVATORS.

Twenty years ago a car carried about four hundred bushels, but those now being built carry twelve hundred bushels. The building of new roads and improvements in methods of transportation have also reduced the price of grain carrying to terminal points in Minnesota nearly, if not quite, 66 per cent. But little more than ten years ago it cost twenty-six cents a hundred pounds to ship wheat from Minneapolis to Chicago; to-day the same amount is carried for ten cents. Twenty years ago it cost from 15 to 18 cents a bushel to ship wheat from Duluth to Buffalo; to-day a rate of three cents a bushel would be excessive. At that time a good cargo was 30,000 bushels; now those figures may be multiplied by ten. A great grain market, created and fostered by an extensive system like that at Minneapolis, has made a radical change in the problem of storage construction.

THE MODERN TERMINAL ELEVATOR.

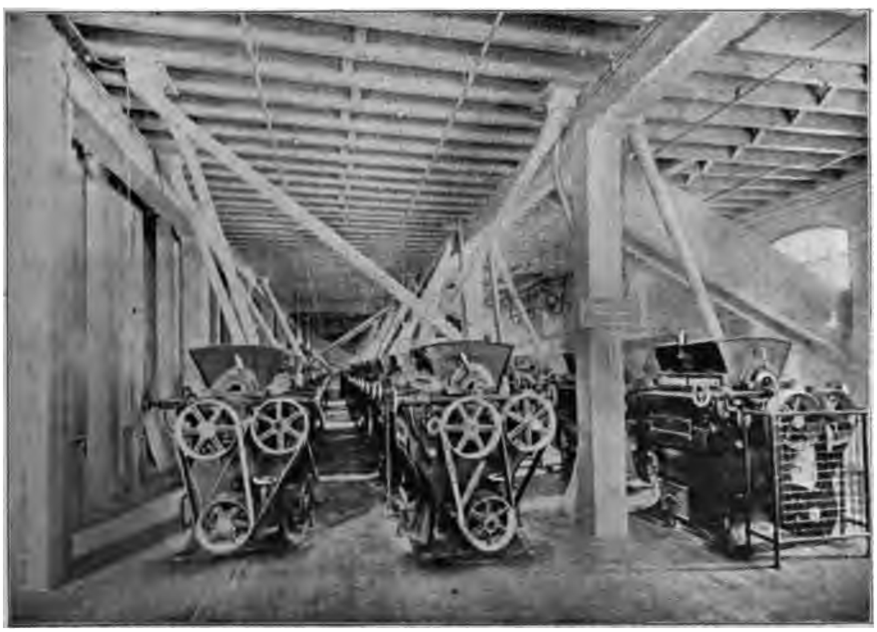
The modern terminal elevator, which is a child of necessity, has reached its present

development through as many evolutions, perhaps, as those of the modern flour mill. There has been no change in recent years in the methods of operating a terminal elevator, except that in some cases electricity has been substituted for steam as power, and that in a few instances, the grain is conveyed by pneumatic tubes instead of by cup-belts. But the shape and material of the structures have been completely revolutionized. Some years ago, in this process of evolution, steel began to supplant wood as building material, and the Great Northern steel elevator of Duluth, which is capable of storing more grain under one roof than any other elevator in the world, is made wholly of steel.

By courtesy of the "Scientific American."
BAKING BREAD IN ELECTRIC OVENS.

OUTSIDE STORAGE TANKS.

Cylindrical tanks for storage next began to be erected outside of and separate from the elevator, instead of the long bins in the elevator proper. Some are made of steel, some of tiling and some of cement. A wide, flat, rubber belt carries the grain from the upper story of the elevating plant, or



GRINDING FLOUR, PILLSBURY "A." MILL.

working house, to the tanks, and discharges it through a hole in the roof. When grain is shipped from a tank it is conveyed from the bottom of the structure through a subterranean passage to the elevator pit on a belt similar to the overhead belt which carries it to the tank. From the pit it is elevated to the shipping floor and spouted to a car.

It is possible to keep grain making this circuit continuously, from the pit to the top of the "working house" by the cup-belt to the top of the tank by the horizontal belt, to the bottom of the tank by gravitation, and then to the elevator pit again by the underground passage. Somtimes, damp grain is treated in this way to dry it. A conveying belt is three feet wide, and the stream of grain which falls upon its surface is from six to seven inches in diameter. A six-inch stream will empty a tank of about five thousand bushels of wheat in an hour. Each plant consists of a dozen of these tanks, more or less, and their capacity is about 100,000 bushels each. These are much more expensive than the old-style houses, but the extra expense is offset in a few years' time by the saving in insurance. Being strictly fireproof no insurance is carried on the structure or its contents. Thus, while the mills have passed from the primitive to the modern era, and the methods of transportation have been improved, the elevators have kept pace with these improvements.

TESTING SAMPLES OF FLOUR, PILLSBURY MILLS.

STATE SUPERVISION OF TERMINAL GRAIN MARKETS.

In addition to the great industries already mentioned, Minnesota has a system of state supervision over the grain market at its terminal elevators, in which the grain dealers of the whole world are vitally interested. Other states adopt similar measures, but do not compare in efficiency with this big cereal state of the northwest. Certificates issued by Minnesota are accepted without question. In Illinois, the elevators are regulated by state commissioners.

THE GRAIN PRODUCTION OF THE UNITED STATES, IN BUSHELS, FOR CERTAIN YEARS, IS AS FOLLOWS:

	Indian Corn.	Wheat.	Oats.	Barley.	Rye.
1890	1,489,970,000	339,262,000	532,621,000	67,168,344	25,807,472
1895	2,151,138,580	467,102,947	824,443,537	87,072,744	27,210,070
1900	2,105,102,516	522,229,505	809,125,989	58,925,833	23,995,927
1901	2,111,107,411	531,645,723	811,745,654	59,634,156	23,756,435
1902	2,412,110,376	533,472,076	812,465,000	60,474,001	24,656,374

PILLSBURY "A" MILL. THE LARGEST FLOUR MILL IN THE WORLD. CAPACITY, 15,000 BARRELS DAILY.

From the following table, taken from the "Year Book of the Department of Agriculture," may be seen the relative food values possessed by various grades of flour, together with the refuse matter.

Components.	High-Grade Patent Flour.	Bakers' Flour.	Common Market Flour.	Flour of Small Mills.
Water	12.75	11.75	12.25	12.85
Proteids	10.50	12.30	10.20	10.30
Ether Extract	1.00	1.30	1.30	1.05
Ash	.50	.60	.90	.50
Moist Gluten	26.00	34.70	24.50	26.80
Dry Gluten	10.00	13.10	9.25	10.20
Carbohydrates	75.25	74.05	75.65	75.30

From the same authority are tabulated the following figures pertaining to a representative brand of self-raising flour.

Components.	Self-Raising Flour.	High-Grade Patent Flour.	Bakers' Flour.
Water	12.30	12.75	11.75
Proteids (factor 6.25)	10.10	10.50	12.30
Moist Gluten	27.00	26.00	34.70
Dry Gluten	9.65	10.00	13.10
Ether Extracts	.70	1.00	1.30
Ash	4.00	.50	.60
Carbohydrates	72.90	75.25	74.99

RAILWAYS, THE ARTERIES OF COMMERCE

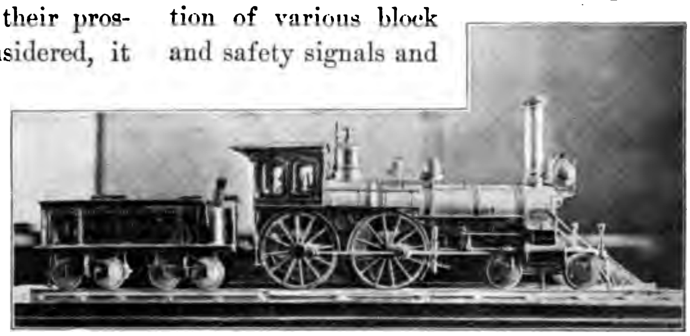
IMPROVEMENT IN THE CONSTRUCTION AND OPERATION OF RAILROADS.

The entire steam-track mileage of railways in the United States, in 1902, was 204,787. To this must be added 70,105 miles of second and side-track, making a total of 274,892 miles of track. In other parts of the world there were 300,000 miles more, which gives our own country about two-thirds of the entire mileage of the world.

If the actual cost of construction and equipment, the production of the materials out of which the lines are built, the employes engaged in railway operation, and the interests which depend for their prosperity on the railway, are considered, it may be safely said that the railway is the greatest industrial factor in the world.

In the handling of these great agencies of commerce, may be seen the handiwork of the skillful executive, and the able and efficient financial management for which our American roads are noted. Then, too, ingenious inventors, are devoting their attention to the bringing forward of new ideas and new devices to promote the construction of an up-to-date railroad.

In every direction, East, West, North or South, old roads are being reconstructed and new ones are being built, with the utmost care to assure the permanency of their tracks, the economy of their administration, and the comfort and safety of passengers. Heavy, ninety-pound steel rails have supplanted the light ones of iron, and rock ballast is now used instead of sand, as heretofore. Steel bridges span the streams, where once wooden structures sufficed. Iron culverts lessen the danger of being burned away, and curves and grades are straightened or leveled wherever such a thing is possible. In the mountainous district, tunnels are being dug through the earth that the trains may not have to surmount steep grades. In the large cities the roads are being elevated or are already elevated, thus eliminating grade crossings, and the perfection of various block and safety signals and safety switch systems, helps to give additional security to traffic and make high speed possible.



By courtesy of the Chicago & Alton Railroad Company.
THE FIRST COAL-BURNING LOCOMOTIVE.

MODERN TRAIN EQUIPMENT.

Train equipment has improved with the increase in travel and the railway journey may now offer comforts and luxuries at a moderate price. But recently have the eastern railroads put on "Twentieth Century" trains, which make the run from Chicago to New York, a distance of 940 miles, in 20

hours. Such trains are equipped with palace sleeping and dining cars, drawing room and observation cars, a library, barber shop, cafe, card room and music room. These trains are lighted with electricity and are considered the most handsome and commodious in the world.

Modern, Up-to-Date Dining Car on the Chicago, Milwaukee & St. Paul System.

RAILWAYS ABROAD.

In every part of the world a spirit of energy rules in railway construction. On our own continent, our neighbors to the North and South are active. One transcontinental line crosses Canada, a second will soon be completed to Hudson Bay, and the Mexican Republic has, within a recent period, completed the construction of 10,000 miles of railway within its borders.

Surveys have also been made for an intercontinental railway to connect North and South America by way of the Isthmus of Panama. In South America, the Andes range of mountains has been a difficult obstacle for transatlantic lines to overcome, but already the mountains have been penetrated and within the next five years the locomotive will be able to run from ocean to ocean. The Argentine Republic and Brazil have also been penetrated with lines of railway, and even in Asia, the whole political and military situation has been affected by the construction of the Trans-Siberian railway, built by the Russian government.

Trains on the Siberian railway are equipped as our own railways in America are, with sleeping and dining cars of Russian pattern. These trains also have bathrooms, gymnasiums and a church car, which travels with the train at intervals, in which priests hold services for the benefit of the faithful while they are speeding through the heart of Asia.

GREAT TUNNELS OF THE WORLD

While America possesses several ingeniously constructed bores in the earth for means of transit, it does not claim a reputation for great tunnels. The greatest length of any tunnel in the United States is the Hoosac tunnel, four and three-quarter miles long. Most others do not much exceed a mile. It consumed 21 years to build the Hoosac tunnel and cost $15,000,000. Of late years, rapid transit in the great cities has become such a serious problem, that its solution, in some cases, has lain in the construction of underground railways, so that the city streets may be relieved of their great congestion. For years, the engineers of the world have been at work to devise the best methods to construct these tunnels.

LONDON'S THREE TUNNELS.

London has been successful already, and now possesses three great underground railway systems, besides having in projection several others. The systems cost over $200,000,000 and were completed only after scores of contracts had been made and broken. The mileage of these systems is about 150 miles.

BOSTON AND NEW YORK TUNNELS.

Boston has a very good system for short distances, and New York has under construction a system that will rival that of London. The New York undertaking is marvelous. Twenty-one miles of tunneling has to be done under the busy traffic of the most congested city of this continent. The streets are threaded with conduits, sewers and gas and water mains, and, sadly enough, one great disaster has occurred through an explosion which cost many lives, and wrecked some of the great buildings of New York. When the subway is completed, it is expected that the 21 miles can be traversed in about 18 minutes. The time required at present is over an hour. The bore is 50 feet wide, reaching almost from

By courtesy of Lawrence & Co.

SHIELD SHOWING MODERN METHODS OF CONSTRUCTING WATER CHANNELS FOR LARGE CITIES.

Tunnel extends three miles under Lake Michigan to Intake. This picture is taken 200 feet underground by flashlight. The construction of the tunnel is made by means of compressed air.

curb to curb of the street above it, and is 17 feet high. It traverses the city from the post office building to Ninety-sixth street, and is so constructed that it will accommodate four tracks. Two of these will be used for express trains, and two, for local. The cars will be equipped individually with motors, and will be run by electricity. At certain points the tunnel reaches near the surface, so that stations may admit people to the trains. Here the tunnel is flat-roofed, and is supported on pillars. From the post office to Thirty-third street there is one main tunnel, and at this point, it branches into two tunnels. At Forty-second street, the tunnels come together again, and so continue to the end. Enameled brick is used for lining the bore, electric lights, placed in niches in the wall, illuminate the place, and entrance to and exit from the tunnel are made by separate stairways.

THE CHICAGO TUNNEL.

Chicago is discussing at present the feasibility of subways for its crowded street car traffic. Already there is a bore constructed many feet below its principal thoroughfares, almost large enough to admit cars. This tunnel is to accommodate conduits for compressed air tubes for the transmission of mail and express packages, and for telegraph, telephone, and electric light wires. It will probably be only a short time before the right will be given to widen this tunnel, and street cars will be run through it.

PARIS METROPOLITAN RAILWAY TUNNEL.

Of city tunnels, that which the Paris Metropolitan Railway built for its three transverse lines, all of which, one above the other, run under the Grand Opera House in Paris, is among the most notable. The stage portion of the "Opera" is 12 or 14 stories high, four or five of which are underground, and one wonders how much of a subterranean journey a passenger will be obliged to take to board a train on the nethermost of the transverse lines, that running from Autenil to La Madeline.

The Alps are most notable for great tunnels. There is the Arlberg, six and a half miles long; the Mount Cenis, seven and a quarter miles; St. Gothard, nine and a quarter miles, and Simplon, which will be 12¼ miles long when the builders get through the mountain.

THE ST. GOTHARD TUNNEL.

About 1855, when the people of the Alpine country tired of packing their goods by mules over the mountains, they resolved upon a tunnel. Work was begun, in 1857, with pick axes and crowbars. The work was done both in France and Italy, but so slow was the method that from two to eight feet a day, only, could be bored. After driving at the rocks for five years, a Frenchman, named Sommeiller, invented a drill that could bore a hole in 20 minutes which men could not dig in two hours. After that the work went on at a greater pace, and the tunnel was finished in 1871.

RAILROAD THIRTY-ONE MILES LONG, COSTING $52,000,000.

Communication by tunnel had hardly begun between France and Italy when work was begun on the St. Gothard railway. This necessitated more tunnels, and the result was the most stupendous system in existence today. The St. Gothard tunnel has its northern entrance near the small village of Goeschenen, Switzerland. It is 14,920

meters in length, and has a double roadway. It was finished about 1881, and the time consumed in its construction was eight years. This road, though a short one, was built at an expense of $52,000,000, passing through one of the most mountainous countries of the world, crossing 14 viaducts, 115 bridges, and traversing 79 tunnels, with an aggregate length of about 31 miles. The railway follows the valley of the Reuss River, running southward from Lucerne, and rising gradually as it passes the jagged Spannorter, and the glacier of Schlossberg. Every mile of progress entails tedious ascent, for the route lies past the Britenstock, Oberalphstock, and the Grosse Windgall, mountains, over 10,000 feet high. When the grade becomes too steep for the mountain-climbing locomotive, the road dives through the heart of the mountain and winds spirally upwards in constant ascent. In one of the tunnels, called the Pfaffnesprung loop, a rise of 155 feet is attained, and the road then comes out upon a terrace, where the climbing is easier. Next comes the Wattinger tunnel, where another incline takes the road for an ascent of 75 feet. At this point the line turns upon itself in a long loop until the Liggestine tunnel is reached, and another ascent of 82 feet is made. Shortly, the great St. Gothard tunnel is reached, and the road plunges through nine and a quarter miles of solid rock. From this point, gradually, it begins its downward course through the interiors of four mountains, at last reaching the plains more than 3,000 feet below. The tunnel of St. Gothard passes under a mile of solid earth, to say nothing of the Lake of Sella, which lies about two-thirds of a mile above its roof. Towering 6,000 feet above the tunnel, is the Kastlehorn. So great is the pressure of the earth on the tunnel that twice it crushed in. Now the roof and walls are held in place by huge arches of masonry, 15 feet thick at the sides, and ten feet, at the roof. The building of the tunnel took one year for each mile and the cost was $11,350,000. With the most improved drills, compressed air, etc., the workmen could progress only 14½ feet in a day.

MINE TUNNEL, COLORADO.

THE ARLBERG TUNNEL.

Another great bore through the Alps is the Arlberg. This is about as long as Mt. Cenis,—six and a half miles,—yet it took only about one-fourth of the time to build

it. It was begun in 1880, and progressed at the rate of 27¾ feet a day, finishing in 1884. This tunnel facilitates trade in Austro-Hungary by connecting the province of Von Arlberg, through the Arl mountain, with the rest of the Austrian Tyrol.

Prince Torlonia built one of the earliest, successful, European tunnels, between 1854 and 1876, over the route used by Emperor Claudius, of Rome. The old emperor is said to have used 30,000 laborers, for 11 years, on this tunnel, to drain Lake Fucino, which at that time covered 48,000 acres of fertile land. Soon after it was first completed, however, it fell into ruins. Prince Torlonia rescued it at an expense of $4,800,000. It is three and a half miles long, and in some places, runs 400 feet below the surface of the ground.

MT. CENIS TUNNEL.

Mt. Cenis Tunnel is situated 16 miles from Mt. Cenis between the province of Turin in Italy and the Department of La Savoie, in France, at the junction of the Graian with the Cottian Alps. Its total length is 40,084 feet or 7.6 miles. The elevation of the southern entrance above the sea is 4,237 feet; of the northern entrance, 3,802 feet; of the terminating point, 4,247 feet. The tunnel is broad enough for two double lines of tracks. It was begun August 31, 1857, completed December 26, 1870, and cost $1,500,000.

The first tunnel built in the United States was that on the Union Canal, constructed between 1818 and 1821. It was 450 feet wide, 20 feet high and 80 feet wide, but has since been made an open cut. Twenty months' building put through a noted subwater tunnel for the Grand Trunk Railway under the St. Clair river. This bore is 6,050 feet long, and cost $3,000,000. Many of the western railways of the United States have tunnels that they may well be proud of, although generally in this country, tunnels are avoided where possible by making detours. The Great Northern Railway has a tunnel in Montana over 6,000 feet long, and Mullen's tunnel, on the route of the Northern Pacific Railroad, strikes through the Continental Divide of the Rocky Mountains.

At Idaho Springs, Colorado, is being constructed, to facilitate mining operations, a tunnel which starts at the base of the mountain, and will penetrate the range at a depth of many thousand feet below the mines, which are worked far up toward the summit. Its course lies through about 86 of the best known and most productive gold and silver veins in Colorado.

THE SIMPLON TUNNEL.

As to the Simplon Tunnel, the longest in the world, The "Engineering Record" says: "The northern terminus of the tunnel is readily reached by railway from Geneva. Its purpose is to save about seventy-seven kilometers in the railway distance between Paris and Milan, as compared with the Mont Cenis and St. Gothard routes. This saving is between seven and eight per cent of the total distance, and to effect it will involve the expenditure of 69,500,000 francs.

"The total length of the main tunnel will be 19,770 kilometers; elevation of first portal, 686 meters; second portal, 634 meters; summit height of tunnel, 704 meters; summit height of mountain, 2,840 meters; surcharge of tunnel, 2,135 meters; maximum rock temperature, cent. degrees, 40.0."

SCIENCE THE BENEFACTOR OF THE FARMER

WONDERFUL ACHIEVEMENT BY THE IOWA EXPERIMENT STATIONS.

"How can I best feed my corn to increase its feeding value?" has been a leading question with thousands of farmers for years. The idea of marketing the grain on the hoof in the form of beef or pork, instead of in a bag, is not a new one, but while corn is conceded to be the greatest of all meat-forming cereals, there is something lacking. In order to secure this something, the farmer mixes with his corn some concentrated feed such as cottonseed meal, linseed meal, blood meal, gluten meal or gluten food.

PROTEIN AN ESSENTIAL IN CATTLE FEED.

The element lacking in raw corn is nitrogen, commonly termed "protein." Protein is necessary to form bone, muscle, lean meat, tissue, the hair on animals and the feathers on fowls. It is most difficult to grow economically; hence the use of concentrated feeds which contain from two to four times as much protein as corn in its raw state. The corn and other grains fed in connection with these concentrated feeds form what is known as the "balanced ration," the value of which was discovered in 1864 by Dr. Emil von Wolff, the eminent German scientist, who published, for the first time, standards based upon the digestible nutrients of feeding stuffs. It was Dr. Wolff's idea to determine the feeding ration that would supply in the correct proportions the carbonaceous, nitrogenous and fatty elements necessary to secure the best growth and development of our farm animals, without the waste of any of the nutrients.

Farmers did not take kindly to the idea at first,—"nothing can improve corn," they said; but the agricultural colleges proved that Dr. Wolff's methods were not only practical, but absolutely necessary to insure the greatest profit in the development of young, growing animals, and finishing cattle, hogs and sheep for market. To-day, thousands of progressive farmers use, and understand the value of, the "balanced ration," but, large as the growth of the idea appears, it is nothing compared with what the future will bring forth. The work of Dr. Wolff, aided by our own scientists, has been worth millions of dollars to the American farmer, and these millions will be increased tenfold as the adoption of the balanced ration grows apace.

When the hot winds of the summer of 1891 seared the growing corn and destroyed a large portion of the crop, the farmers and feeders were confronted with the most serious problem in the history of their business. A short corn crop, no grass, and a heavy demand for beef and pork, brought them face to face with an almost insurmountable difficulty, unless they could feed the grain then rapidly advancing in price, at a profit. Farmers who had adopted the balanced ration began to think and figure more closely as to the probable value of concentrated feeds,—which of them con-

tained the highest percentage of digestible protein,—which of them would produce the greatest gains in flesh for the amount of feed consumed? This serious study of the feeding question has undoubtedly resulted in greater progress and enlightenment during the year 1892 than in the previous ten years combined.

PATENT MEDICINAL STOCK FOODS.

People who talk about the beef trust and complain about trust prices, have not the remotest idea of the trials and tribulations of the man who produces the beef. One of the greatest evils with which the farmer has to contend is the patented, medicinal stock-foods, manufactured at a cost of less than $30 per ton, and sold at prices ranging from $150 to $200 per ton, or more. These mixtures usually consist of the cheapest of mill feeds, such as bran, low grade corn meal, wheat middlings, etc., to which has been added a small amount of sulphur, Epsom salts, charcoal, fenugreek and other drugs. The manufacturers claim that these mixtures will not only promote digestion and increase the appetite, but will cure every ill that the animal is heir to; the same mixture that is recommended to cure gapes in fowls is also recommended to cure hog cholera, and guaranteed to make cows give more milk. The makers of the so-called foods with all the force of the English language at their command, played upon the credulity of the farmer to such an extent that thousands bought heavily, hoping to make their corn crop of 1901 last longer and fatten the stock quicker, but in a majority of cases the result was the opposite from what was expected. Other disturbers of the farmers' tranquillity were the scarcity of feed, and the high prices of animals suitable for finishing at a profit.

THE IOWA AGRICULTURAL COLLEGE EXPERIMENT.

In January, 1901, the question of feeding cattle in such a way that would net the farmer a profit became almost a national issue. To settle the question of feeds, and especially, medicinal stock foods, the Iowa College of Agriculture decided to plan and conduct a feeding test that would determine the feeding value of the various concentrated feeds, as well as the several makes and brands of stock foods on the market. It was the idea of its promoters to make this test the most extensive of its kind. There had been numerous other tests, but all had been on such a small scale as to be of no practical value to the farmer.

The test as planned was carried to a successful termination on a famous Western farm. From a herd of over 700 range steers, 220 representative animals were selected, and all were of as uniform quality as it was possible to get them. The bunch of 220 was divided into eleven lots of 20 head each placed in separate feed lots under conditions such as can be secured on any farm in the corn belt. Wheat straw was the "roughness," and corn the only grain fed throughout the entire test. Lot No. 1 received a daily ration of corn and wheat-straw; the other lots were fed on concentrated feeds and medicated stock foods, as follows: Lot No. 2, linseed oil meal; lot No. 3, cottonseed meal; lot No. 4, gluten meal; lot No. 5, gluten feed; lot No. 6, germ oil meal; lot No. 7, blood meal; lot No. 8, Iowa stock food; lot No. 9, International stock food; lot No. 10, Standard stock food; and lot No. 11, corn and green pasture.

The feeding test extended over a period of 94 days. The steers had previously been

fed a partial grain ration for several months, and were just good average animals. At the conclusion of the test the cattle were sold on the Chicago market, and the results published by the Iowa experimenters in an official bulletin. In the table of profits as given by the bulletin, a wide variation is shown; the rations of gluten meal, and corn and wheat straw, returned a net profit of $3.50 per steer, more than was returned by the ration of corn and wheat straw alone; the gluten feed and corn returned a net profit of $3.11 more than the straight corn ration. The medicated stock foods proved to be a detriment to the feed of corn, the net profit, per steer, being from $1.40 to $8.16, less than was returned by the straight corn ration. There was an advantage of 97 cents per steer in feeding dried blood, 48 cents, in green pasture, and 36 cents, in oil meal. Cottonseed meal resulted disastrously; after 42 days, several of the steers died suddenly, and the rest went blind and were marketed.

The test further proved that corn worth around 60 cents per bushel on the open market, actually returned a net value of 93 cents per bushel, when fed alone; $1.04 per bushel, when fed in connection with gluten meal; and $1.03 per bushel, when balanced with gluten feed; but the value was reduced 21 and 22½ cents per bushel, when the medicated stock foods were used.

Professor W. J. Kennedy, vice director of the Iowa station, and instructor in Animal Husbandry, originated the experiment and with the aid of his assistants, Professor F. R. Marshall and R. J. Kinzer, a graduate student, had entire charge of the work. All are young men, yet in the "twenties," and are enthusiastic in their work of teaching the farmer how to feed along scientific (common-sense) lines. Professor Kennedy says that this was undoubtedly the greatest feeding experiment ever undertaken in this or any other country. It proved that no matter how high or low the price of corn may be, its value may be increased by adding the by-products of the grain known as gluten meal and gluten feed. The farmer may now sell a portion of his corn crop, feed these "concentrates" liberally, and not only save a part of the money made by the sale of his own corn, but realize a greater profit from his fat cattle. This, though astonishing, is nevertheless a fact.

BY-PRODUCTS OF CORN.

In the march of scientific progress, the farmer has received a good share of the benefits. Corn, the most versatile of all our farm crops, is made to yield nearly 100 separate and distinct products, of great value to art and science. Of these by-products gluten meal is made by first soaking the grain; then, by mechanical devices, the different parts of the kernel are separated. First the germ is taken out, and then the bran, which is the husk of the corn, is separated from the gluten and starchy portions; the gluten and starch are then separated by a filter process; the starch, being the heavier, sinks to the bottom, while the gluten runs off, and is kiln-dried and ground into meal. Gluten feed is a mixture of gluten meal and fancy corn bran. Both of these products are highly concentrated and contain a high percentage of digestible protein, the element lacking in raw corn. The farmer can buy in one ton of either of these feeds, as much flesh material as there is in three tons of corn, and at,

practically, the same price that a single ton of grain will cost.

Prominent feeders throughout the West consider the Odebolt test the greatest achievement in the history of the cattle industry.

POULTRY KILLING BY MACHINERY

Poultry-killing by machinery is the latest innovation made by the big packers at the Union Stock Yards, Chicago. In olden times the method used for slaughtering fowls was to catch them and wring their necks or chop off their heads with an ax or large cleaver. To-day that process has been superseded by one that, while it may not seem humane, is by far the most rapid method ever introduced for killing chickens, ducks, geese or turkeys.

THE FATTENING ROOM.

In describing this twentieth-century method of slaughter, let us begin at the time when the chicken or turkey reaches the packing house. The fowls arrive in car lots and are at once transferred to the "feeding-room," where they are kept for ninety days, to "fill out." Then, if at the end of that period they are found to be fat enough to slaughter, the killing is begun.

KILLING 10,000 CHICKENS, 8,000 DUCKS AND 6,000 TURKEYS PER DAY.

THE KILLING FLOOR.

From the feeding room to the "killing floor" there is a chute through which the fowls are "shot" into a cage which acts as a receptacle on the floor below. Standing directly in front of this cage is a man whose duty is to lift the birds from the cage and place them upon an endless chain, which runs directly in front of him. In placing the fowl upon the endless chain it is turned upside down, both feet being placed in small prongs, spread a sufficient distance apart to make picking possible.

Then a weighted tin can, which weighs about eight ounces, is attached to the bill of the fowl by a "snap." The bird is still alive.

This ends the man's duty at the cage, and the bird moves along to the next man, who sticks an awl into its gullet, which kills it. Then the blood drips down into the weighted can and later finds its way to the fertilizer works, where it is utilized. After this operation the bird continues on its way, passing en route 20 men, each of whom, in turn, removes a few of the feathers as it passes along. Eight of these men are stationed inside a great iron cage, and it is their duty to pick off the best feathers, which are saved and sold to pillow manufacturers.

When the fowl has reached the end of the chain it is taken off by a man and passed over to an inspector. Should there still remain any small feathers upon it, it is taken to a hook which projects from the wall, and there gone over by a "cleaner." At the conclusion of this operation, if the inspector is satisfied, it is placed upon the racks, and within a few minutes, is wheeled into the big coolers. This is what is known as the dry picking process.

THE SCALDING PROCESS.

There is also a scalding process, which is operated upon a similar plan, only that after the bird has been "stuck," it is drawn along on an endless chain, which carries it through a "scalding tub," where the feathers are removed. It then goes into a "cooling tub," and later, finds its way to the cooler.

So rapid is this method of killing fowls that in a day of ten hours, 10,000 chickens, 8,000 ducks and 6,000 turkeys may be slaughtered. The average wages earned by men in this department are $1.75 per day. It is not an uncommon thing for the packers to have 40,000 fowls in the "feed room" at one time. This enables the shippers to cool and pack to advantage.

GIGANTIC ICEBERG OF NORTHERN GREENLAND.

HOW GLASS IS MADE TO-DAY

Glass making has come to be one of the fine arts. Not only is much of our domestic ware made of glass, but bric-a-brac costing thousands of dollars, exquisite colored windows, and even delicate scientific instruments come from the hands of the glassmaker.

MELTING THE SILICATES.

The minerals used nowadays for glass manufacture consist principally of silicates, such as lime, potassium, lead and soda, and other ingredients are used, including phosphorous, magnesium, tin, iron and bismuth. These ingredients are mixed after a proper formula and are heated for weeks in great porcelain crucibles, specially prepared for the occasion and ending their service with one baking.

For weeks, a terrific heat is kept up within a great furnace, and this mixture is finally brought to its proper molten consistency. The master workman repeatedly tests the glass by means of a stirring paddle, through what is called the "glory" hole. When the mixture is just right, a large iron mold, which is to receive the fiery mass, is brought up ready for the pouring, and placed between the heating furnace and another furnace known as the "cooler." The inside of this iron mold is dusted with a quantity of fine sand, to prevent the absorption of impurities from the iron by the glass. After these preparations have been made, a signal is given, a number of workmen tear down the walls of the furnace, and by means of a huge pair of tongs on wheels, the crucible is lifted and drawn from the furnace. The workmen, lest the glass lose too much of its heat, cover the crucible over with a mat of asbestos until it has been brought to the iron mold. The grappling irons on the crucible are changed so that by means of pressure on a bar, the pot may be overturned. The second signal is given, and gently, without great splutter or noise, the fiery liquid flows into the mold.

This mold is covered by an iron lid, and a crane picks up the whole thing and running it along a portable tramway, slides the cast glass into the cooling furnace.

FINISHING LENSES.

Gradually, during several weeks, the glass gives up its heat within this furnace. When it is removed, it looks more like sanded glass than a future object glass for a great telescope. Polishing now must be done until the lens becomes clear. Even then it is not ready for scientific uses, for, after the testings to which it is put, it must go back once more to the furnace for a better heating, and be perfected to anneal. The next cooling takes about two months. Then the real lens makers set to polishing it to a degree of extraordinary fineness. When the bare glass, free from serious flaw, reaches the hands of the lens maker it is worth about $5,000; when it leaves him it has grown in, value very much—sometimes as much as $25,000.

MAKING THERMOMETER TUBES.

Of other kinds of glass manufacture, that of making thermometer tubes is very interesting. The heating of the glass is much the same as in other methods. The

furnaces are within a long corridor. At the right temperature, a workman plunges a blow pipe into the glass, attaching a small lump of the molten material to the end of it. This for some time is blown and whirled, until it grows to about the size of an apple. A little more glass is then added, and the lump is rolled and kneaded on an iron kneading board. When the proper amount of rolling has been done, another workman quickly attaches the end of his blow pipe to the glass, and runs rapidly backwards away from the other, down the corridor. Both men all the time blow fiercely into their pipes. In a trice they have a small glass tube about the size of one's finger, and perhaps 300 feet long, lying on the floor of the corridor. This can readily be broken up into desired lengths for use in thermometers, barometers and other scientific instruments.

IRRIGATION OF THE NILE REGION

BARRAGE AT ASSIOUT—2,750 FEET LONG.

SOUTH OR UPSTREAM SIDE OF THE DAM AT ASSOUAN, FROM WEST BANK.

Total length, 1¼ miles; maximum height above foundation, 130 feet; difference of water level above and below, 67 feet. Total weight of masonry, over 1,000,000 tons.

The monumental dam at Assouan, which is by far the greatest achievement of its kind in ancient or modern times, forms a reservoir in the Nile valley capable of storing 1,000,000,000 tons of water, practically creating a lake more than 140 miles long. The foundation stone was laid by the Duke of Connaught on February 12, 1899. At times fifteen thousand men have been employed, and work has gone on day and night. At other times, when the Nile was in flood, labor had to be suspended for several weeks.

One gains a clearer idea of the magnitude of the task by recalling the first step taken; that was, to divert the channel and excavate in the rocky river-bed a trench one hundred feet wide and as many feet deep, in which to lay a concrete foundation for the massive piers.

At its best, and controlled, the Nile is very generous, as befits the majesty of its three thousand miles. Joseph the Israelite drew some of his prosperity from it. One of the irrigation canals he planned for Pharaoh's people is still in use. But in most moods the Nile is a sullen and inconstant stream, and even in the days when Egypt was the granary of imperial Rome there seems to have been no comprehensive attempt to govern it.

THE GREAT DAM AT ASSOUAN.
Entrance to locks of navigation channel from the south.

Napoleon had a faint perception of the thing that needed to be done when he suggested a dam near Cairo. That, he realized, would double the cultivable area around the river's mouth. In the earlier portion of the 19th century two barrages were actually built at that spot by a French engineer—badly built, however, and useless until, of recent years, the British reconstructed them. This work consists, in effect, of two brick arched viaducts crossing the Rossetta and Damietta branches of the Nile, having, together, 132 arches of 16-feet-four-inches-span, which were entirely closed by iron sluices during the summer months, thus heading up the water about 15 feet and throwing it at a high level into the six main-irrigation canals below Cairo. In the summer months the whole flow of the Nile is arrested and thrown into the aforesaid canals.

The most important of the works constructed to enable the water stored up in the great reservoir to be utilized to the greatest advantage is the barrage across the Nile at Assiout, about 250 miles above Cairo, which was commenced by Sir John

Aird & Company in the winter of 1898, and completed in 1902. In general principle this work resembles the old barrage at the apex of the delta; but in details of construction there is no similarity, nor in material, as the old work is of brick and the new one is of stone. The total length of the structure is 2,750 feet, or rather more than half a mile, and it includes 111 arched openings of 16 four-inch spans, capable of being closed by steel sluice-gates 16 feet in hight.

The object of the work is to improve the perennial irrigation of lands in Middle Egypt and the Fayoum, and to bring an additional area of about 300,000 acres under such irrigation by throwing more water at a higher level into the great Ibrahimick Canal, the intake of which is immediately above the barrage.

The total length of the dam is about a mile and a quarter; the maximum height from the foundation is about 130 feet; the difference of level water above and below, 67 feet; and the total weight of masonry over 1,000,000 tons. Navigation is provided for by a "ladder," of four locks, each 260 feet long by 32 feet wide. As with the case of Assiout, the difficulties in dam construction are not in design, but in the carrying out of the works. When "rotten rock" in the bed was discovered, Sir Benjamin Baker frankly reported to Lord Cromer that he could not say what the extra cost and time involved by this and other unforeseen conditions would be, but that, however bad the conditions, the job could be done. He was told to go ahead with the work.

The first channel was successfully closed on May 17, 1899, the depth being about 30 feet and the velocity of the current about 15 miles an hour. In the case of another channel, the closing had to be helped by tipping in railway wagons themselves, loaded with heavy stones and bound together with wire ropes, making a weight of about 50 tons—this great mass being necessary to resist displacement by the torrent. These rubble dams were well tested when the high Nile ran over them; and on work being resumed in November, after the fall of the river, water-tight sand-bag dams, or "sudds," were made around the site of the dam foundation in the still waters above the rubble dams, and pumps were fixed to lay dry the bed of the river.


THE NAVIGATION CHANNEL ENTRANCE LOCKS FROM THE NORTH.

This was the most exciting time in the early stage of the operations, for no one could predict whether it would be possible

LOOKING TO THE EAST ALONG THE TOP OF THE DAM.
Regulating gear for sluices to the right.

to dry the bed, or whether the water would come pouring through the fissured rocks in altogether overwhelming volumes. Twenty-four 12-inch centrifugal pumps were provided to deal if necessary with one small channel; but, happily, the sand bags and gravel and sand embankments staunched the fissures in the rock and the interstices between the great bowlders covering the bottom of this channel, and a couple of twelve-inch pumps sufficed.

ARMY OF WORKERS.

The masonry of the dam is of local granite, set in British, Portland-cement mortar. The interior is of rubble set by hand, with about 40 per cent of the bulk in cement mortar, four parts of sand to one of cement. All the face work is, of course, rock-faced ashlar, except the sluice linings, which are finely dressed. The maximum number of men employed on this dam was 11,000.

OLD SYSTEM OF IRRIGATION.

The old system of irrigation was little more than a high Nile flooding of different areas of land or basins surrounded by embankments. Less than a hundred years ago, perennial irrigation was first attempted to be introduced by cutting deep canals to convey the water to the lands when the Nile was at its low summer level. When the Nile rose, these canals had to be blocked by temporary earthen dams, or the current would have wrought destruction. As a result, they silted up, and had to be cleared of many millions of tons of mud each year by enforced labor, much misery and extortion resulting therefrom.

Moreover, the old canals and the dams at the delta barely touched the surface of Egypt's irrigation problem, the problem of avoiding drouth and making waste lands fertile. The great dams at Assouan and Siut, "inaugurated" in the summer of 1903, go to the bottom of things in more than one sense of the word.

At Assouan, near the First Cataract, nearly six hundred miles from Cairo, the Nile is a mile wide. The dam is a quarter-mile wider, a great granite wall that rises ninety feet above the

EARLY IRRIGATION IN EGYPT.
Most primitive methods of farming prevail.

level of low Nile, and is sixty feet wide at the top.

When the river is in flood, its waters gush through one hundred and eighty massive sluice-gates. In autumn the sluice-gates are closed until the reservoir thus formed is full, ready to be distributed through canals and ditches over the agricultural land on either side. In April and August, when the water is most wanted for the crops, the supply in the lower river is increased from the reservoir.

THE DAM AT SIUT.

At Siut, about half-way between Assouan and Cairo, is a subsidiary dam a half-mile wide, with more than one hundred sluice-gates. Broadly speaking, the two reservoirs add $400,000,000 in land values to the region covered by their operation.

OLIVE CULTURE ON AN EXTENSIVE SCALF

THE WORLD'S BIGGEST OLIVE ORCHARD.

The United States has no rival as far as climate and other resources are concerned. In the West India Islands which we have acquired, in Samoa, in the Hawaiian Islands, and in the Philippines, can be produced every tropical product that has a commercial value. Hereafter, we may grow our own spices and tropical fruits, our coffee and our hemp, and numerous other peculiarly tropical productions, which are not produced in the United States proper.

RESOURCES OF THE UNITED STATES IN CLIMATE AND SOIL.

In our own country, between the Atlantic and the Pacific, from British America on the north, to Mexico on the south, we have such a variety of resources from the soil and the mountains, from the forests and the plains, as to make us almost absolutely independent of the world's markets, if by chance we should be isolated from them. It is true that no part of the United States is in the tropics, yet in Southern California and Florida the balmy climate makes the cultivation of most of the more important tropical plants possible.

In Southern California is located the largest olive orchard in the world. There are also others that outclass the olive groves of the Mediterranean in size. Only in a limited area of central and southern California, and in New Mexico and Arizona, can the olive be produced, in this country. It is quite certain, therefore, that there will not be an over production.

ORIGIN OF THE OLIVE IN CALIFORNIA.

Olive orchards in Italy are looked upon as perpetual fountains of wealth. It is more than a hundred years since the first of these orchards was planted by the Spanish mission fathers of California, who did so much to influence the early industries and life of that state when it was a part of Spanish Mexico. The success of their olive-tree cultivation proved the adaptability of the climate, and ever since that time the industry has been steadily growing. From the olives that are grown in California is produced from 24 to 31 per cent of oil. They are richer and more palatable, when pickled, than are the imported green olives from Italy. The de-

mand for ripe olives is steadily on the increase, and in the year 1902 it was about 30 per cent more than in the preceding year.

THE OLIVE TREE MORE VALUABLE WHEN OLD.

The older the olive tree becomes, the more valuable it is to its owner, because of its prolific bearing. The wood of olive trees is highly prized by cabinet makers, for it is exceedingly hard and susceptible to a high polish.

THE WORLD'S BIGGEST OLIVE ORCHARD.

This mammoth enterprise is located at Sylmar, twenty miles from Los Angeles, California, in a beautiful amphitheater in the Sierra Madre mountains.

The ranch contains more than 120,000 trees. There are 1,200 acres under cultivation, covering an area whose greatest length is three miles and whose breadth is two and one-half miles. Each acre contains 110 trees, and it is estimated will produce 2,000 gallons of olives yearly for the next 20 years. This amount will make 250 gallons of oil, which, at $2 per gallon, will make the revenue $500 per acre. There are forty miles of roads within the ranch. Two hundred and ten thousand dollars has been invested in the orchard and $15,000 in the factory. The crop of 1903 is valued at $225,000.

TEN TIMES LARGER THAN SPAIN'S GREATEST.

Although the olive tree has been cultivated for more than 4,000 years, and olives have formed a staple food of some of the oldest races of earth, yet the young orchard at Sylmar is ten times as large as the largest olive orchard in Spain or the Holy Land.

One hundred and fifty men are employed in gathering the olives in harvest time, which is throughout the months of November, December, January, and on into February. The olive berries frequently weigh down the branches until they touch the ground. Two hundred pounds is a good average day's pick, at an average wage of about $1.50 per day.

The Sylmar ranch was planted about 1894, and the trees yield about 50 pounds of olives each. An olive tree does not come into bearing until it is four or five years of age. As the trees are supposed to live 4,000 years, indeed, some of the trees on the Mount of Olives, in the Holy Land, are known to be over 3,000 years old—an olive orchard may be reckoned on permanently.

BILLOWY EXPANSE OF SILVER GRAY.

The big olive orchard at Sylmar presents a vision of surpassing loveliness. As far as the eye can reach it is one sweeping, billowy expanse of silver gray. The olive trees themselves are not unlike willows in their graceful, somewhat drooping, silhouette. The trees are arranged in orderly rows, and near at hand one sees the peculiarly beautiful shade known as olive green, which becomes a silver gray whenever a breath of wind discloses the under side of the leaf. In the distance the perspective reduces the size and assembles the trees, producing an effect much like a waving field of grain.

The earth on the surface is always carefully pulverized, and, consequently, the water has been drawn up by capillary attraction. There is a strong underground seepage from the surrounding hills.

MAMMOTH SICILIAN OLIVE TREES.

In Sicily, olive trees have been known to attain enormous size, one having grown to the dimensions of 26 feet in circumference, with an expanse at the top of fully 150 feet.

Italy produces, annually, 70,000,000 gallons of olive oil; Spain, 23,000,000, and the United States, about 7,000,000.

The olive berry always grows on new wood, and, in order to increase the yield, the tree is "cut back" and new wood springs out, which bears fruit the second year. It is said that the roots of the olive tree extend as far into the earth as the branches rise above the soil.

GATHERING THE CROP.

The olives are carefully gathered in canvas buckets made for this purpose, and are brought to the factory in spring wagons, to keep them from bruising. The berries are gathered when ripe, although "ripe" olives are frequently "green" in color. After they reach the factory the olives are graded into "ones," "twos," or "threes," according to size. They are then put into a solution of one pound of lye to ten gallons of water. This takes out the bitterness. Here they remain a week to ten days. Then the lye is soaked out by fresh running water, and if they are for table use they are put into a solution of brine, where they remain permanently until bottled up or shipped away.

The olives to be used for oil are gathered from the tree a good deal riper than those used for the table. The oil is extracted by a series of "crushers" and hydraulic presses, which are composed of materials that will not absorb odors, stone and metal being used as much as is possible.

CRUSHING AND PRESSING.

In Italy the olive fruit is crushed and pressed by a simple process. A platform of strong masonry is made about 40 inches high and ten feet long, the surface of the top being slightly hollowed. At the center a strong, vertical, wooden axis is erected, to which is affixed, at right angles to the platform, a millstone about 12 inches broad and weighing about 1,600 pounds. By means of a shaft and yoke beam, a donkey, or ox, slowly moves the stone around. The olives are emptied into the mill trough and crushed to pulp, one attendant constantly turning the mass over with a shovel. In half an hour about 200 pounds can be thus crushed. The thick pulp is then put into soft flat rush baskets, each having only a small aperture in the top, and these are arranged in the press in layers, one above another, up to 15, mouth upwards. Wooden boards are then laid across, and then comes the strong cross beam of the press. To this is attached a strong wooden screw, worked by a lever in the hands of six or eight men, first slowly, then faster, and finally screwed home. The oil flows readily, and runs through a shoot into a hogshead below, filled up to four-fifths of its capacity with water, so that as the oil runs in, the heavy impurities may be deposited and the soluble matter taken up by the water, leaving the oil to collect on the surface. The pulp is thus passed through the mill, two, three or four times, and the final residue, amounting to about 70 per cent of the original fruit, is mostly sold to the large oil works, where it is worked over again. Formerly, it was disposed of to the bakers for heating their ovens.

HOW RUBBER IS MADE TO-DAY

But two centuries have elapsed since rubber was known only as a curiosity; to-day it is in common use in nearly every industry and household.

THE PROCESS OF KNEADING.

The system by which crude rubber is brought down to merchantable condition, is a simple method of kneading by steam rollers. First the crude rubber is soaked in hot water for several hours. After this operation, it is cut up into pieces of convenient size and run through a washer, which is a machine equipped with heavy corrugated steel rollers. Here it passes through and through until it is crushed and mangled, all the time being washed clean of bugs and other impurities, that get into the rubber tree. The rubber is very sticky and after the washer has completed its work, one sees nothing but a sticky mass in long sheets. These are allowed to dry and then are run through heavier rollers.

THE PROCESS OF MIXING.

After this process the rubber is run through the "mixers," which consist of large hollow steel rollers having steam pipes inside of them, to furnish heat in the operation of mixing, and also a set of water pipes by which the rubber may be cooled when necessary. Through the rollers the rubber passes. So adhesive is it that it sticks fast to the rollers and has to be constantly cut off by means of a sharp knife, and thrown back, for another rolling. Great power is needed for this process because the sticky mixture retards the rollers. When the kneading is all but completed, a coloring compound is added to the mass to give it the tint desired in certain kinds of uses for which it is intended.

THE PROCESS OF COMPRESSING.

After this, the rubber is run through four polished steel rollers, one above the other, and here it gets its proper thickness. These rollers or "calenders" are used also for crushing the rubber into cotton ducking, for making rubber cloth, etc.

Manufactured rubber goods are made by this method of compression instead of by melting and pouring into molds.

THE PROCESS OF VULCANIZING.

Charles Goodyear discovered the process of vulcanizing rubber, a process which consists in changing the chemical composition of rubber by heat, whereby its sticky and

YOUNG RUBBER TREE.

elastic properties are removed and the rubber is given greater durability. This process consists in submitting the rubber to a great pressure under heat, by means of hydraulic presses. Generally, about 2,000 pounds are brought to bear, and the presses are connected with steam so as to secure the desired heat.

ODD METHOD OF VULCANIZING RUBBER BELTS.

An odd method is employed to vulcanize rubber belts. A stretcher is used to take the stretch out of the belts. This is made up of two sets of heavy clamps, and a great hydraulic ram which exerts a pressure of 2,000 pounds to the square inch. In this manufacture, the belting has already been made by pressing the rubber into the cotton duck. This is now cut into strips of desired length, and the strips are laid, one over the other, until the thickness of the desired belt is obtained. Then a strip of thin, pure rubber is wrapped about the several folds. The whole belt may then be put into a steam press and vulcanized.

RUBBER HOSE.

When rubber hose is made, a rubber tube is first slipped over a mandrill, and cotton-duck stripping is wrapped about it until the desired thickness is attained. Then, a thin sheet of rubber is rolled about it all. This is covered with strips and sent to the vulcanizing press. The press consists principally of an iron pipe which is thrust into the hose. Steam is admitted to the pipe and the hose is heated. When the process is over, compressed air is blown between the hose and the pipe to remove it. Firemen's hose, with its cotton outside, is made by drawing a rubber tube within the cotton tubing, and then the whole is charged with steam.

RUBBER TREE IN U. S. BARRACKS, KEY WEST, OVER 100 YEARS OLD.

HOW SALT IS PRODUCED

While salt is mined in many foreign countries, much of the supply of the United States comes from the wells of Kansas and New York, from Salt Lake, in Utah, and from Michigan, Louisiana, Ohio, West Virginia, Nevada and California. Salt blocks are often erected in the vicinity of forests where there are sawmills, so that the refuse from the mills may be used as fuel.

THE MANISTEE (MICHIGAN) SALT WELL.

One of the best equipped plants for salt manufacture is located near Manistee, Michigan. Under the great forest near Manistee is a stratum of salt nearly 30 feet thick, lying about 2,000 feet from the surface of the earth.

PUMPING 2,400 BARRELS OF BRINE IN 24 HOURS.

After a derrick has been built about 80 feet high, the process of manufacturing salt in this vicinity is somewhat as follows. A well is driven by means of pipes and a sand pump, until by the pressure of air pumps brine can be forced to the surface. This brine is pumped at the rate of about 2,400 barrels in 24 hours. As the brine is brought up it is stored in great cisterns. From these cisterns the brine is drawn to settlers, where it is subjected to a heat of 170 degrees F. Then it is allowed to cool and let the impurities settle. Gypsum is the principal impurity, and if it were not drawn off it would form a coating on the machinery of the plant and would clog it.

THE "GRAINER."

The brine now is taken into a long box over what is called a "grainer." This device consists of a long, shallow tank in the bottom of which are several steam pipes. When the brine has been admitted to this the steam is turned on, the brine is heated and evaporation rapidly takes place. To assist in this operation paddles are at work stirring the brine. As rapidly as the brine cools, the salt forms at the bottom of the grainer, and in 24 hours a layer will be found nearly eight inches deep. From this point the salt is lifted by perforated shovels to a runway, and as soon as it is drained, it is shoveled into cars and taken to the storage bins.

One of the plants near Manistee has five

By courtesy of the "Little Chronicle."
PLOWING SALT, WITH THE TEMPERATURE AT 140°.

wells, three cisterns, each 100 feet long, 8 feet deep and 18 feet wide, and six settlers capable of holding 24,000 barrels of brine. These cisterns and settlers when filled hold enough brine to make 10,000 barrels of salt.

THE VACUUM METHOD.

Another process for salt making is called the "vacuum-pan" method and consists in heating the brine in a large air-tight cylinder, where it is boiled by steam. The air pressure is removed to some extent in this boiler and at 150 degrees F. the evaporation is very rapid. The grains of salt fall to the bottom of the cylinder, or "pan," and by means of an endless-bucket belt the salt is taken automatically to bins for draining. After it has drained about 18 hours, it is stored away. Some plants have two pans working, one for day and one for night, for it is necessary to clean the pans every 12 hours. The capacity of each pan is 600 or 700 barrels of salt daily.

COMPRESSED AIR DRILLS BREAKING PACKED SALT.

Salt plants generally have a great supply of salt on hand. It is stored in great sheds several hundred feet long, and frequently become so hardly packed that it is difficult for the laborers to break it up. Coarse salt does not pack so tightly as the vacuum salt. The latter kind often gets as hard as a wall of marble. Then men must work at it with pickaxes, shovels and even compressed air drills. These drills are about ten inches in diameter and are mounted on trucks, so that they may be wheeled about easily. To bring down a quantity of packed salt, a row of holes is drilled about six feet into the wall, a few inches above the floor. Enough will then fall in to keep a gang of men packing for a number of days.

DRAWING SALT IN CALIFORNIA. By courtesy of the Southern Pacific Railroad Company.

The following paragraph is taken from the "Little Chronicle," of Chicago:

STEAM PLOW TURNS UP SALT CRUST EIGHT INCHES THICK.

In the southern part of California, in a region known as the Colorado Desert, near the Colorado River, is a deposit of salt covering 1,000 acres. It lies over 250 feet below sea level and was formed by salt springs. Over this area a crust of crystallized salt, eight inches thick, has formed so hard that it has to be turned up by a steam plow. A company has been taking out salt for fifteen years undisturbed, but last December the United States got out an injunction against it for mining on public land. The suit is still pending in the courts. When the question is settled there will be great activity in the region. Only ten acres have been touched. A great drying and milling plant has been erected at Salton, an artesian well sunk, and a big town of Japanese and Indian workers built up. White men could not work in temperatures of 140 degrees over the glittering white field. The Indians wear colored goggles and suffer intolerable thirst, which the alkaline water of the single artesian well fails to quench.

HIGH-GRADE TOBACCO GROWN UNDER MAMMOTH TENTS

A SHREWD YANKEE'S SCHEME TO REVOLUTIONIZE THE TOBACCO MARKET.

In Connecticut is found a remarkable innovation in tobacco culture, consisting of a tent covering eight acres, devoted to this purpose.

EXTRA FINE QUALITY BRINGS 43 CENTS PER POUND EXTRA.

There are others in the same district, and under these broad canopies Sumatra leaf tobacco is grown, so much finer in quality than that raised in the open fields that it commands 68 cents per pound, while the latter brings but 25 cents.

In 1892, Ariel Mitchelson, of Tariffville, Connecticut, inaugurated the idea of growing tobacco under cover. At a cost of $250 per acre he tented 18 acres of his best tobacco land with cheesecloth and produced a crop of Sumatra leaf far superior to any theretofore grown in the United States.

First, posts, nine feet high, were put up, one rod apart, on spaces of tobacco land aggregating 18 acres. Over and between the posts stringers and lines of galvanized wire run, and then cheesecloth was spread and drawn taut over all.

ONE HUNDRED AND NINETY-SIX TENT-POSTS TO THE ACRE.

The tents were of unexampled hugeness, and were very strong, for they were fortified 196 posts to the acre, and with an abundance of snap hooks, rings and cloth.

In the tents, Sumatra leaf tobacco was planted, the rows being set out in the different tents at different times, in order that the several crops would ripen one after the other. As soon as the plants began to grow the advantages of the cheesecloth covering began to manifest themselves.

First, there was the freedom from insects; all the evil from that source was quite destroyed.

The soil kept soft. It did not harden nor cake.

In a word, the tents united all the advantages of the open-air and of the hothouse. The plants had the hardy vigor of their out-door brothers, and at the same time they had the fineness that a hothouse's protection gives. By the time early summer had arrived they had reached so great a height that their leaves touched the nine-foot roof.

Men came from all quarters then to admire them. Never had such Sumatra leaves been seen. They were from twenty to twenty-four inches long, thin and of the best imaginable shape and size for wrappers, since each promised to yield two full cuts without waste. The Secretary of Agriculture appeared, and could not praise enough the enterprise of Mr. Mitchelson. Companies for the growing of tobacco in tents began to form and land began to be bought, and land values began to go up amazingly.

TWO THOUSAND POUNDS OF TOBACCO PER ACRE. PRICE, 68 CENTS PER POUND.

Meanwhile the tobacco was harvested. The first trial field of a third of an acre yielded 700 pounds, and sold for $473.70, an average of 68 cents a pound. This price compared well with the 25 cents a pound that was being paid at the time for leaf grown in the old way.

And the tobacco itself compared well with the tobacco grown in the old way. It yielded 2,000 pounds to the acre—an unprecedented yield—and the leaves were of an unprecedented size, an unprecedented shape, and an unprecedented quality. Universally they were admitted to excel the leaves that are grown in Sumatra itself. Sumatra does with America a business in cigar wrappers that amounts annually to $6,000,000. In Connecticut and in Massachusetts, since a way has been found to excel the imported crop, they expect now to take from Sumatra all that business. That is why tents are going up all over the Connecticut and Massachusetts tobacco country—why green fields are coming to resemble great aggregations of colossal circuses.

METHOD OF DRYING TOBACCO.

The accompanying cut illustrates the method of planting tobacco in the tropics. It is not materially different from that followed in the United States. Although a perennial plant, tobacco is grown annually from seed. It flourishes best in tropics, but acclimatizes itself in any country. It is estimated that nearly 2,000,000 acres of the earth's surface are devoted to tobacco culture. Its cultivation is a matter of great care, requiring constant and experienced attention. The rich, moist soil which yields the best, is exhausted of its mineral constituents by tobacco in a greater degree than by any other plant. These minerals form the ashes of burning tobacco. It absorbs from the soil even the chlorine of common salt, which it does not require, and which injures it for use.

PLANTING TOBACCO.

GRADES OF LEAF.

The leaves of the tobacco plant naturally grow in three grades. Those nearest the roots are the strongest, since they have the first call upon the sap of the plant. Leaves half way up the stem are of medium strength, while the topmost are the mildest.

About the beginning of September the crop is gathered. Sometimes leaves are gathered at intervals in order to obtain uniformity of quality. As a rule, the plant is cut down at once by severing the stem in the morning, and then is carefully laid on the ground and exposed to the heat of the sun during the day, the juicy, brittle leaves thus becoming wilted or placid, and bendable without breaking. Before evening, the leaves are carefully collected and stored in sheds.

MONSTER SHIP CANALS.

The necessity of a canal to connect the Atlantic and Pacific oceans has long been apparent and great amounts have been expended in efforts to accomplish it.

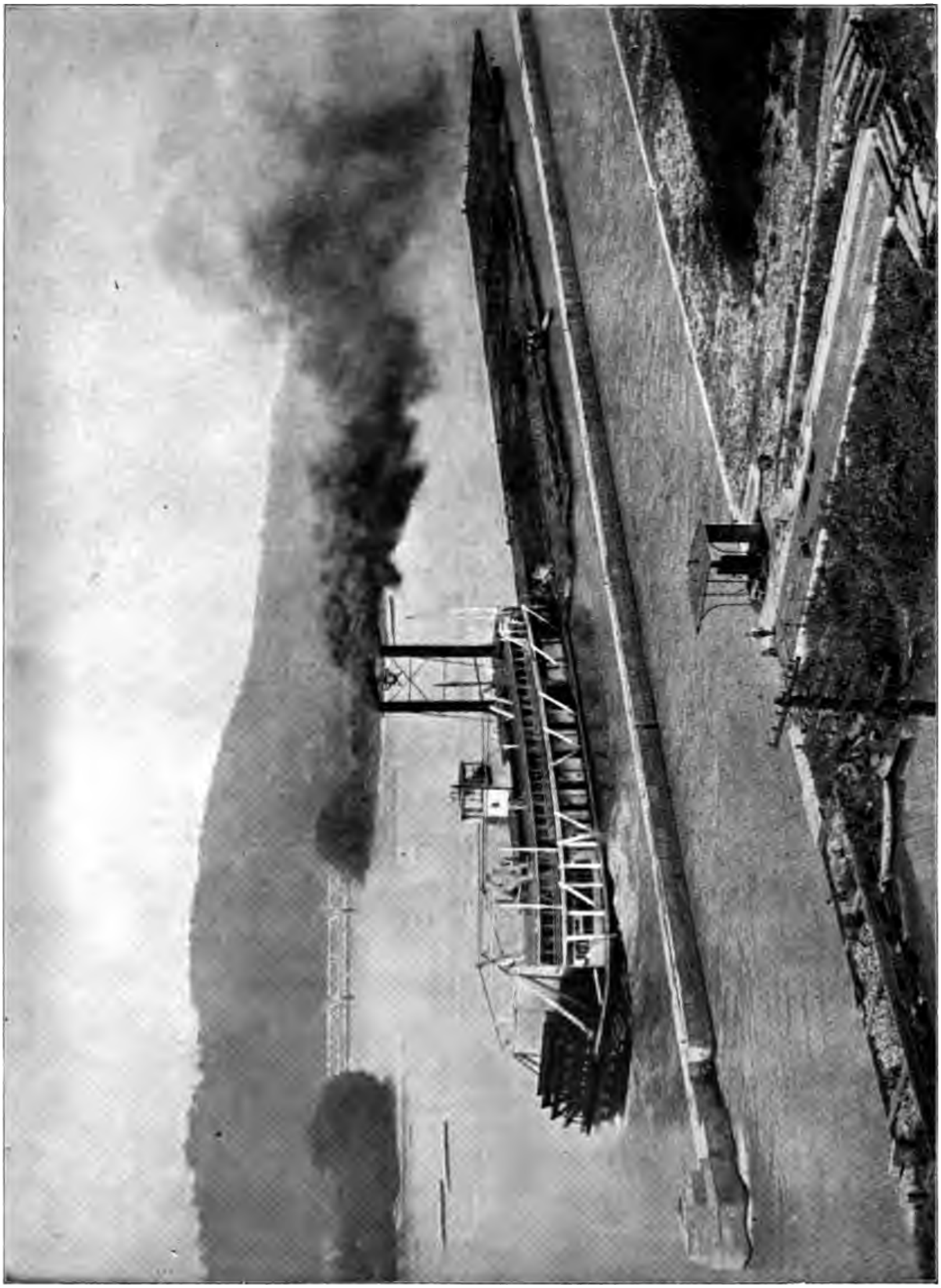
THE PANAMA CANAL PROJECT.

From the standpoint of many expert scientific engineers the Panama route, which followed the course of the waterway connecting Colon on the Atlantic with Panama on the Pacific, was considered more feasible than that across Nicaragua, which was to run from Greytown on the Atlantic side to Brito on the Pacific, and included the use of the San Juan river and Lake Nicaragua. On January 4, 1904, the French bondholders of the Panama route offered their plant to the United States for $40,000,000. It had already been cut about two-thirds of the way across the isthmus. The United States offered Colombia $10,000,000 upon the ratification of the Hay-Herran treaty, which gave the former the right to build the canal. This was rejected by the Colombians and, on November 6, 1903, the American government recognized the independence of Panama and entered into a treaty with the new republic which granted to the United States the control of the canal zone and authorized the Panama Company to sell its rights for the sum offered. On April 27, 1904, the title to the property was formally transferred to the United States.

HOW CANALS ARE MADE.

THE SUEZ CANAL.

The Suez canal, connecting the Mediterranean and Red seas, is 100 miles long and was constructed in ten years at a cost of $100,000,000. The idea of such an artificial waterway first came to Napoleon Bonaparte, but was given up when it was supposed that the Red Sea was thirty feet above the Mediterranean. In 1841, when British scientists proved this to be an error, Ferdinand de Lesseps began to investigate the problem of a canal. In 1856, by permission of the Khedive of Egypt and the Sublime Porte, the Universal Company of the Maritime Suez Canal was formed. Half the capital for conducting the work was raised by popular subscription, mostly in France. The other half was raised by



AN UPWATER CANAL—"STERN-WHEELER" PUSHING RAFT OF LOGS.

the Khedive. Work was begun April 25, 1859, and on November 16, 1869, the canal was opened. for navigation. The route of this canal includes Lake Menzaleh, Lake Timsah and the Bitter Lakes. Originally, the canal was from 150 to 300 feet wide at the surface of the water, and 72 feet wide at the bottom, with a minimum depth of 26 feet. In later years it has been considerably widened and deepened to 28 feet. The British government now owns the shares originally owned by the Khedive. From 486 vessels and $1,031,865 earned the first year of the canal's history, its business has increased nearly twenty fold.

THE CHICAGO DRAINAGE CANAL.

A work of recent construction and great importance is the Drainage Canal of Chicago. The purpose of this canal is to turn backwards the water of the Chicago river that for years polluted Lake Michigan and Chicago's drinking-water supply with the filth of the city's sewers. For years the Chicago river served as a sewer for the city, draining every factory, slaughter house and cesspool of the district. Sanitary engineers believed that a wide canal connecting the Chicago river with the Desplaines river and thus flushing off the water through the Illinois river into the Mississippi would remove this great danger to health. From this canal some day will develop a great waterway from the Great Lakes to the Gulf of Mexico, for, all that is needed is the further dredging of several streams along the route. The water from Lake Michigan flows up stream in the Chicago river and out through a cut that connects with the south branch of the river, to Lockport,

DRAINAGE CANAL VIEW AT LOCKPORT, ILLINOIS.

Illinois, where, through a great dam and controlling works, it runs into the Desplaines river, to Joliet, and through the Illinois river into the Mississippi. The cut is 160 feet wide, is constructed of masonry six feet thick, has a capacity of 600,000 cubic feet of water a minute, and will admit ocean vessels. The whole sewer system of Chicago is being reversed to flow into the canal.

A great agitation was raised in towns along the Mississippi river when the sewage of Chicago was turned into the canal, because of fear that it might contaminate the Mississippi, which furnishes the water supply for those cities. Bacteriologists, however, proved that there was no danger from this source.

THE KILE CANAL.

One of the greatest ship canals of the old world, when completed, will be the Kile, connecting the Baltic with the Black Sea. Work was begun on this in 1898 by the Russian government. The route lies along the River Dnieper which flows into the Black Sea and connects this river with the Dwina river which empties into the Baltic sea at Riga. It begins at Riga, runs along the Dwina as far as Duneberg where it is connected with the Beresina by a great cut across country. Thence the Beresina and Dnieper complete the connection with the Black Sea. The total length of the line is about 1,000 miles and about 125 miles of the distance is through an artificial cut. The canal is 307 feet wide and about 30 feet deep, thus allowing vessels of greatest draught to pass from one sea to the other. The cost of the enterprise will be about $120,000,000, allowing for the use of convict labor by the Russian government. The whole canal will be under Russian sovereignty, thus being of great political significance. Seventeen large ports will be established along the line to enable vessels to make harbor when so desired. The route can be traversed in six days.

CORINTH CANAL—GREECE.

GREAT STRIDES IN THE OIL INDUSTRY

The problem of cheap fuel for steamships, railways and great industrial plants calls particular attention to what has been achieved in the last few years towards the production of oil in the United States, and its use for steam-making purposes. Many years ago the discovery of oil in Ohio and the Central Western states, gave rise to the great industry of refining oils into kerosene and lubricating oils. From year to year, oil was discovered in other states and in foreign countries, so that as an illuminant, it became a household word. But oil was still too expensive to be used in great quantities, and moreover, its output was so completely controlled by the Standard Oil Company, that prices could be regulated at will by a few men and were generally regulated upward.

OIL FIELD NEAR LOS ANGELES, CALIFORNIA.

TEXAS OIL DISCOVERIES STIMULATE THE USE OF OIL FOR FUEL.

With the discovery of oil in the Beaumont district of Texas, however, came the movement to use oil for fuel in many localities, in place of coal and wood. This resulted from the cheap price at which practically unlimited quantities could be secured. Thus many steamships which left Southern ports where little or no coal was obtainable except at a high price, equipped their furnaces for oil. The Southern Pacific Railway was probably in the van in this respect, and now uses oil almost exclusively in its engines throughout the

Southwest. Many other instances of the great value of the oil industry to the Southwest can be recited. Breweries, mills, cotton presses and an almost endless chain of power plants now use oil. Naturally, the steam plants that furnish power to drill new oil wells, use oil from neighboring wells. There are many settlements throughout the country to which the discovery of oil has brought much prosperity. Ohio thrives greatly from this industry, as do Indiana and sections of neighboring states. California has recently shown great oil deposits, and so productive is the spout in northern Texas, at Corsicana, that a visitor views the town as an aggregation of immense derricks,—an oil well in every dooryard. But since Beaumont, away off in the southeastern corner of Texas, has made so noticeable a revival in oil well speculation, it may suffice to tell something of the history of this little place, and of its great oil boom.

By courtesy of the Detroit Photographic Co.
OIL TEAM CROSSING THE SAN JOAQUIN VALLEY, CALIFORNIA.

STORY OF THE TEXAS OIL FEVER.

Numerous reasons have been given for the discovery of the oil at Beaumont. Possibly the most picturesque is that men drew conclusions that a stream of oil flowed under the great state and pointed, as proof, to the oil up north, at Corsicana, and to an oil pool that was constantly swirling in the waters of the Gulf of Mexico, off the coast. Howbeit, in January, 1901, prospectors struck oil. The well proved to be of immense flow. At once the news of the discovery was noised about over the South. More prospectors came to the district, to drill, and before long, a thriving city took the place of the sluggish town of Beaumont.

A boom struck the town. A short dis-

tance away, on a small elevation known as Spindle Top Hill, derricks began to go up until a veritable forest of them appeared. The price of land mounted fabulously, as new oil wells "came in." Fortunes were made in a day. The streets of the little town were thronged with visiting speculators, who were looking for chances of snap investments, or for opportunities to unload stock in any of the numerous oil companies that sprang up. One caught the speculative fever from the atmosphere. It may be well to relate some of the instances of lucky strokes made by the first speculators.

As soon as the news came of the first oil struck, there was one man who had faith in the oil bearing properties of the district, but he had only $20 to his name. Nothing daunted, however, he gave that sum for the option on the purchase of a large plat of ground near where the oil was first discovered. Then, going to New Orleans, he interested several capitalists and expert engineers in the project, organized an oil company, and after drilling some time, came upon a big "gusher." A few months later, without having sold any oil worth mentioning, the company sold the well to another company, for $1,250,000. Immediately after this, drilling was begun on some of the land still retained, and another paying well was found. People of all sorts and means got the fever and invested their money in oil stock, or land. Oil companies by the hundreds were organized within a few months, some of them with no other idea than getting money out of guileless country people, for prettily engraved certificates of worthless stock. Shares in companies were sold over the whole country, some as low as ten cents a share. Rich and poor alike became enthusiasts. Even the street urchins speculated. The writer, one day during the boom, met a bootblack in Beaumont, who offered to sell to him for $800, stock which had cost him only $30, and upon being refused, sold it a few minutes later, at the desired price.

THE NEWSPAPER MAN'S SPECULATION.

A young newspaper man who was well known to several stock promoters, was given an opportunity to buy stock of one of the companies before oil was struck. Not having the money he was given the stock on credit. Within two weeks, half this man's purchase was sold, and after paying for the whole purchase, he had several thousand dollars profit and the other half of his stock. This half of the stock was sold at a high price, but the company's well proved to be only a "duster"—that is, a pocket of gas, but no oil—and the shares were not worth the paper they were printed on.

The speculation in land went on at a tremendous rate. A few wise countrymen, who had barren lands which were not worth more than $2 an acre, sold them for as many thousands. There was little trouble taken to prove ownership, or to record purchases. Transactions involving the transfer of hundreds of thousands of dollars took place in hallways, and corner drug stores, or saloons. One case is known where a plot of land changed hands in a cigar store, for $15,000. A man was standing at the cigar counter lighting his cigar, when he overheard the deal. Casually, he asked the purchaser what he would take for the land he had just bought. On being told $30,000, he snapped the land up as a bargain.

POOR PEOPLE MADE RICH IN A NIGHT.

Many poor people who never knew what riches were, found themselves wealthy in a night. Some of these were thrifty and saved their money. Others spent it foolishly at New Orleans and large neighboring cities. Some of the land owners refused big prices for their lands, expecting still higher figures. Most of these were later disappointed to find their land valueless.

But, aside from the unusual prosperity, of a short-lived nature, as a result of the oil boom, there was the serious and valuable side of the enterprise. As a matter of fact, the wells near Beaumont are capable of giving far more oil than all other known wells. How long this will last, is not known.

A STORAGE TANK HOLDING 500,000 GALLONS.

Already the flow has been so enormous that the pressure has subsided to a great extent. Yet there are still many companies that have arranged big storage tanks, of 500,000-gallon capacity, in some instances, to receive the oil, have built pipe lines to the Gulf, and are arranging for tank line steamers to export the oil.

A serious misfortune overtook these oil fields in 1902. A fire ignited the oil in one of the tanks, and the conflagration spread until all Spindle Top Hill was badly damaged. The damage, however, was repaired.

DRILLING FOR OIL.

The actual drilling for the oil is an interesting work. Derricks, from 75 to 100 feet high, are built of wood. A drill attached to steel tubing, about 12 inches in diameter, is driven into the ground. The tubing is in sections, and as it gradually disappears into the ground, other tubing of slightly smaller diameter is fitted into it, and the drilling is continued. Thus, if the oil is not found until a great depth is reached, the diameter of the well is likely to be small. Samples of the earth and gravel through which the drill is boring are examined from time to time, and

FLOW FROM A 50-BARREL OIL WELL.

the proximity of oil can often be foretold very accurately. When the well does "come in," the oil often bursts forth with great velocity, spouting, sometimes, over a hundred feet into the air. Then there is a hurry and bustle to fit onto the tubing a head with a stop cock in it, to regulate the flow of the oil, and to run it into storage tanks. One of the great advantages enjoyed by the Beaumont wells is, that so far, the oil flows of its own accord, and does not have to be pumped.

THE MODERN PIANO

By courtesy of the Lawrence Co.
UP-TO-DATE METHOD OF MAKING PIANOS.

The most popular musical instrument to-day is the piano. Not many years ago it came under the head luxury, but the increasing culture and education of the people have changed all this and made the piano an every day necessity. Ten years ago there were manufactured in this country considerably less than 100,000 pianos. Last year (1902) there were manufactured 225,000. These figures tell the whole story.

With the rapid development of the refining influences of life has come a demand for soulful music. The young girl's education is hardly considered complete without, at least, a moderate knowledge of the piano.

With such a demand there has come the supply, and the strife of competition has resulted in various improvements in the manufacture of pianos that have kept the art of the builder thoroughly up to date. The old square piano has been almost entirely superseded during the past 15 or 20 years by the upright, and tonal qualities have been so vastly improved that the cheapest piano, to-day, would rank well with the best of 20 years ago. By the introduction of a better quality of feet in the hammer, by the use

By courtesy of the Lawrence Co.
GETTING MATERIAL READY FOR MAKING PIANOS.

of a large hammer and the production of a better wire, the musical quality of the piano tone has been improved even as it has been given greater volume.

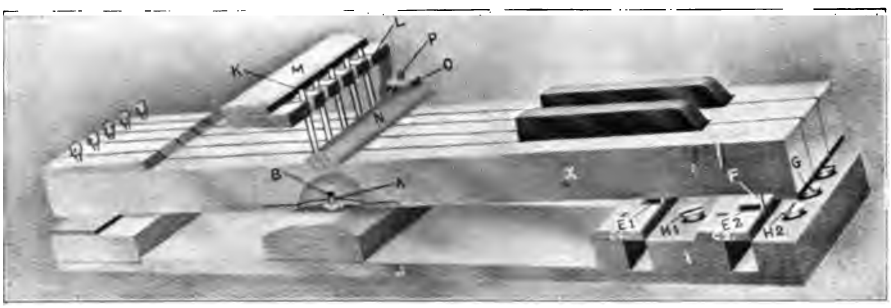
In order to bring the piano up to its present-day artistic worth, innumerable inventions have been patented, each ambitious manufacturer being constantly on the alert to devise a remedy for any suggested imperfection. One of the latest important inventions relates to the keyboard, and in an exceedingly simple way makes such a thing as a "sticking key" an impossibility. The average pianist will be glad to learn that such an improvement exists because everybody has had more or less trouble on that score, caused by dampness or careless construction. This new keyboard does away with all that difficulty, and by giving a firm, elastic touch, enables the performer to produce a more musical tone. Among piano manufacturers this keyboard is considered one of the most marked improvements of late years.

In the general construction of the piano there have lately been devised many improvements.

America produces finer pianos, and a far greater number of them, than any other country in the world.

By courtesy of Reed & Sons' Piano Mfg. Co.

View of the interior of Cabinet Baby Grand Upright Piano; showing the action, keys, sounding board, mouse-proof pedal construction with patent grand metal plate in position ready for use, also patent wheel agraffe.



By courtesy of Steger & Sons Piano Mfg. Co.

THE MOST DURABLE PIANO KEY MANUFACTURED.

MAKING LEAD PENCILS

COMPOSITION OF THE LEADS.

The "leads" of lead pencils are made of a mixture of German pipe clay and "black lead", which is not lead, but graphite. But the first pencils were made of real lead and the name has clung to "lead" pencils ever since. Graphite, or plumbago, is a nearly pure form of carbon and most of the pencils made in this country use the graphite mined at Ticonderoga, Vermont, where the only graphite mine of any consequence in the United States is located.

GRAPHITE.

The graphite is taken in the lump from the mines and carried to the reducing mill, where it is ground or pulverized in stamp mills under water. The fine particles of graphite float away with the water through a number of tanks, collecting at the bottom of these reservoirs. It is packed in barrels in the form of dust and sent to the factory, where tens of thousands of lead pencils are turned out every day.

The pulverized graphite is so fine that it really is dust; it is dingy in color, and smooth and oily to the touch. It is divided into various grades of fineness by floating it on water from one tank to another. The coarse dust sinks to the bottom of the first tank, the next finer, to the bottom of the next and so on down the line, the finest powder, for the finest pencils, settling in the last tank.

SORTING OUT GRAPHITE (PLUMBAGO).
For making Lead Pencils.

GERMAN PIPE CLAY.

In another series of tanks the German pipe clay, which is mixed with graphite to

secure the different grades of hardness, is graded in the same manner by floating. The finest clay is mixed with the finest graphite, and the hardness of the pencil is secured by increasing the proportion of clay in the mixture. For medium grades seven parts, by weight, of clay are mixed with ten parts of graphite.

PROCESS OF MIXING.

The mixing is done under a grinding mill similar to that used in mixing paint, and water is added to facilitate the mixing. The grinding stones are about two feet in diameter and only the upper one revolves. After the graphite and clay are ground together the mixture is put into canvas bags and the water is squeezed out under hydraulic press, leaving the mass the consistency of putty. This plastic material is placed in the forming press, which is a small iron cylinder in which a solid plunger or piston works up and down. A steel plate having a hole the size and shape of the "lead", is put under the open end of the cullender, and the plunger, pressing down, forces the graphite through the hole, making a continuous thread or wire of graphite.

As long as this thread is moist it is pliable, but it becomes brittle when dry, so it is handled rapidly. It is cut in three-lead lengths, straightened out, and then hardened in a crucible over a coal fire. The leads when taken from the crucible are ready for the wood.

DIFFERENT KINDS OF WOOD FOR PENCILS.

Pine is used for cheap pencils, an ordinary quality of red cedar is used for better pencils, and nothing but Florida Key cedar is used in the best.

CUTTING CEDAR STRIPS.

The sawmills at Tampa, Florida, cut the cedar blocks about seven inches long, and these are sawed into strips wide enough for six pencils; but as pencils are made in halves, each strip is thick enough only for a half pencil. When these strips are received in the factory they are run through a machine which cuts in each one six grooves, round or square, and at the same time smooths the face of the wood.

FILLING THE STRIPS WITH LEAD.

The filling of the strips is done by girls. The first one takes a grooved strip of wood in her left hand and a bunch of leads in her right. She spreads the leads out fan shape, and with one motion fills the six grooves with leads. Next to her sits another girl who takes the filled strip, and quickly and neatly lays on it another grooved strip, which has just been given a coat of glue by a third girl.

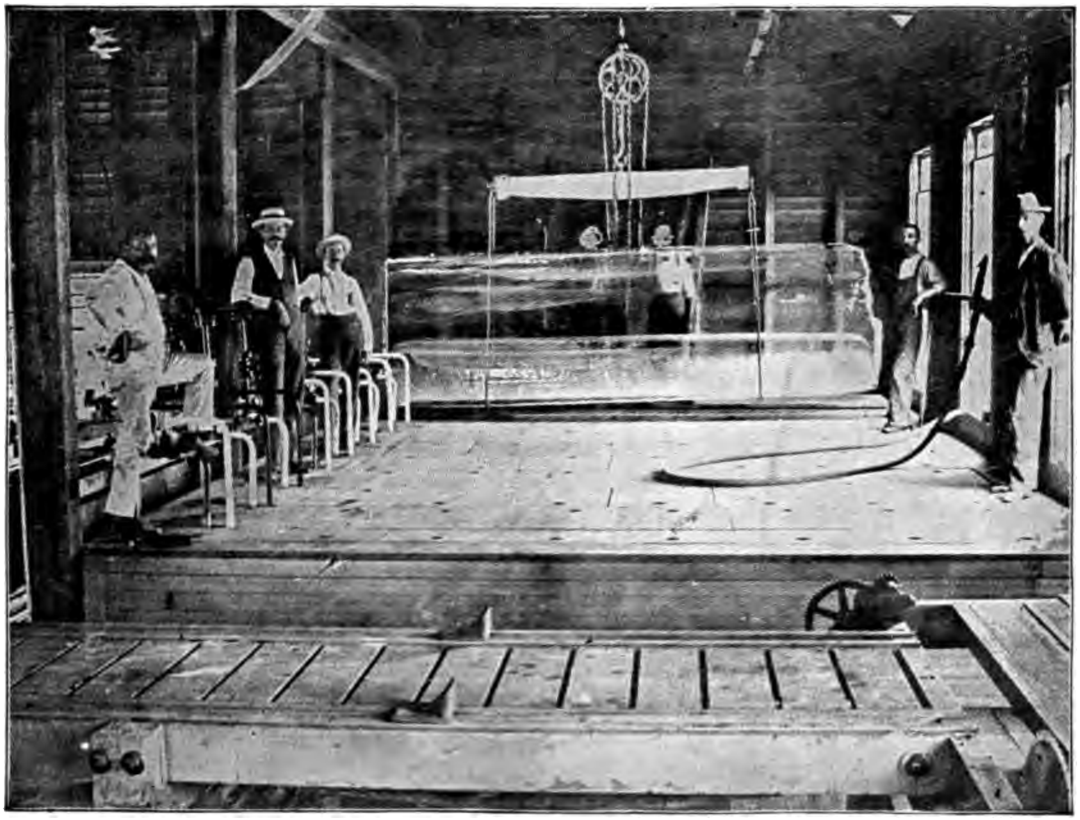
THE FINISHING PROCESS.

The filled and glued strips are piled up and put in a press to dry. The ends of the strips are evened off under a sandpaper wheel, and then the strips are fed into a machine which cuts out the individual pencils, shapes them and delivers them smooth and ready for the color polish in six streams. The coloring is done in liquid dyes, after the pencils have been sent through the varnish machine. Then follows the stamping, finishing and counting. This latter work is done by quickly filling a board having 144 holes in it, thus counting out a gross of pencils.

ARTIFICIAL ICE

In this day of progress, when everything in nature is being reproduced by man, it is little wonder that the demand for ice has resulted in the discovery of methods of manufacturing it. While the natural ice crop is still depended upon for the greater portion of the civilized world's ice supply, yet so far have the devices for ice making been perfected that artificial ice is now a strong competitor of the natural product in all large cities.

But of even greater value than the supply of man-made ice for domestic use is the method of artificial refrigeration which will permit great ocean liners to store away tons of perishable food for transportation, without taking on a supply of ice. This same method also saves much time and expense in all great, cold-storage plants, such as egg houses, beef coolers and breweries, to say nothing of the plants which store thousands of spring chickens, turkeys, etc., from one year to another.



By courtesy of the Smith-Valle Co., Dayton, Ohio.
MAKING ICE.

THE PRINCIPLE OF REFRIGERATION.

The principle upon which artificial ice is made and refrigeration produced is that

of absorption of the heat in the surrounding atmosphere. This is done in a number of ways. In making liquid air, which is the coldest substance known, the process consists in making use of the law of nature which insists that compressing a gas warms it and then liberating it quickly cools it. Thus air is compressed and all the surplus warmth taken from it by spraying the pipes which contain it with cold water. Then when this cool and compressed air is liberated it expands with such rapidity that the warmth in the surrounding atmosphere is absorbed and a great cold is produced. This same principle is applied in a little different manner in the practical use of ammonia in making ice for commercial use.

WARMTH TAKEN FROM THE WATER.

The idea is that anhydrous ammonia, which freezes at 32 degrees Fahrenheit—so cold is it—upon being brought in contact with water, will take from the water its warmth.

THE CAN SYSTEM.

The ammonia method is the one most universally in use both in making cakes of ice and in keeping down the temperatures of cold storage warehouses. One method for using ammonia is called the can system. In its use, water in cans the size of the cakes of ice to be manufactured, is exposed to the ammonia circulating through coils of pipe laid in a tank of salt water. The ammonia absorbs the heat from the salt water and the salt water in turn freezes the water in the cans by absorbing its heat. Where storage rooms are to be cooled with making ice, the ammonia is pumped through pipes which run about the rooms and thus absorb the warmth in the air at first hand. In this process the air around the pipes, of course, is the coldest in the room. Thus the moisture that may be contained in the air nearest the pipes will be precipitated on the outside of the ammonia pipes in the form of thick snow ice.

ICE MADE FOR 50 CENTS PER TON.

One of the most efficient methods for ice manufacture is called the Holden system. By its use ice can be made for 50 cents a ton in a very small plant as against a cost by the can system of nearly $2 a ton.

THE PLANT NECESSARY.

The plant necessary in this system consists of a device for circulating the ammonia without loss and the ice machine. The former consists of three vertical pipes, 12 inches in diameter, and 40 feet high. These are called the still, the absorber and the condenser. Besides these there are two shorter pipes called the interchanger and the cooler, while an ammonia pump furnishes the power for circulating the ammonia.

PROCESS OF MAKING ANHYDROUS AMMONIA.

Strong ammonia liquor of 32 degrees, Bane intensity, is pumped through the interchanger to the stop of the still. In the interchanger, it is practically heated. In the still, which is a device full of pipes which break up the ammonia into small drops, the ammonia is heated by steam and allowed to trickle down, giving off, the while, a strong ammonia gas. This gas passes out to the top of the absorber which is filled with pipes carrying circulating water. Here the gas is converted into anhydrous ammonia of exceedingly low temperature, and is ready to pass to the ice machine to do its work in the making of ice.

THE ICE MACHINE AND ITS OPERATION.

The ice machine consists of a hollow cylinder supported by hollow trunnions, the whole affair revolving in a tank of water. The anhydrous gas passing into this cylinder through one trunnion creates a very low temperature which at once takes up the heat that is in the tank of water. All the time the cylinder is revolving a thin film of ammonia clings to its inside walls. On the outside the water changes to a coating of ice. This is removed by knives which scrape off the ice in the form of "spawls." These "spawls" naturally rise to the top of the water in the tank, and as they accumulate, are conveyed by a screw propeller to great presses. These presses are hydraulic and are so arranged that all the water and air which is carried to them with the "spawls" of ice are squeezed out, thus leaving blocks of ice clear and solid as crystal. After the ammonia gas has done its work, it passes out through the other trunnion of the ice cylinder, finds its way through the absorber, receiver, etc., and, mixing with the weaker ammonia water of the first operations, begins its journey again with the pump to the still.

A SUBSTITUTE FOR IRON IN BUILDING

Cement as a substitute for iron is being tried with considerable success in the building world. For years it had been thought that nothing but iron could be used in the construction of buildings, but it remained for a Chicago architect to devise a cement which, it is claimed, will, in many instances at least, make an excellent substitute for iron.

This cement is made like ordinary cement, but does not have for its ingredients the same amount of sand, water and cement as that used in preparing mortar for the building of sidewalks. When a beam has been made of cement it is tested by being subjected to a weight placed anywhere between the supports upon which the beam rests. In one of the big buildings recently erected at the University of Chicago, 60,000 square feet of cement flooring takes the place of the same number of feet of iron girders, and there are a number of 25-foot spans which have successfully stood all tests to which they have been subjected.

COMPRESSED AIR—WHAT IT MEANS TO THE WORLD

In this latter day, when every known method of time and labor saving is being tested and rapidly put into use, the value of compressed air has become so apparent that every large city, and many smaller places, are making some use of this power. Some of the larger cities use it as a means of transmission of mail, packages, etc., about the city, from place to place. This type of pneumatic tube is the most advanced and it is only of recent development.

PNEUMATIC TUBES.

The most common use to which compressed air is put for carrying purposes is that in pneumatic tubes in the great stores,

hotels and newspaper offices. By means of brass tubes leading from a central station to every section of a store, or to the numerous rooms of a hotel, power is conveyed. At the central station there is a pump which develops an air pressure of about 2 pounds to the square inch of pipe surface. For long distances and for great speed, where much use is made of the system, greater power is necessary.

In each station where the tube is used there is a receiving and sending apparatus. Two pipes complete the circuit, one with air traveling away from the central station and the other with it rushing toward the home plant. The sending device differs according to the necessities of the occasion. Many plants which do not need heavy pressure simply have an opening in the tube covered by a lid. When it is desired to send something, a small leather or metal box, conical in shape, and with furry ends to make it fit closely to the tube, is opened, and the article is enclosed, after which the sending box is closed and dropped into the tube. It takes only a few minutes for this box to travel about a mile. When it reaches its destination it falls into a box which is provided with a door, and is so arranged that the power may be cut off before opening it to take out the carrier. Some receivers simply have a lid held in place by a strong spring, so that when the carrier is forced against it, it gives way and the carrier falls out upon a desk.

ITS SERVICE IN GREAT HOTELS AND STORES.

By means of these pneumatic tubes money for payment of articles is carried in stores from sales clerk to cashier and the change and receipt for the purchases are returned. In hotels, mail is delivered over the entire building, sometimes over 15 floors or more. Newspapers, calling cards, etc., are also sent to guests.

ITS RELATION TO NEWSPAPER WORK.

In newspaper offices, these tubes play an invaluable part. All the copy for news matter, advertisements, etc., is "spouted" to the composing room with great rapidity, thus saving the bother of a host of messenger boys, as well as doing the work without loss of time. One feature of the newspaper work is the great pneumatic tube service in the large cities, in use by newspaper associations. Such bureaus as the great Associated Press, which sends out tens of thousands of words of news matter daily, could never do so speedily were it not for the great serpentine tubes that wind about below the city pavements connecting its headquarters with every newspaper office which receives its service. By this means the "hottest" news is shot over to the newspapers in time for publication, whereas were messengers used, the delay might be vital.

USEFUL IN THE POST OFFICE.

Of late years the United States Post Office Department has been an active user of compressed air. Several cities are now served by pneumatic tubes and are able to send mail from postal headquarters to branch stations with very little loss of time. Packages weighing several pounds may also be sent. One of the greatest of these systems will shortly be in operation in Chicago. The cost will be many millions of dollars, but the improved service in dispatching mails and in collecting them will amply repay for the outlay.

CLEANING FURNITURE, CARPETS AND RAILWAY COACHES.

Aside from the use of compressed air in pneumatic tubes, this agent has been found valuable in many other capacities. One of the most common uses to-day is that in cleaning. A hose is attached to a compressed air pump and by means of a nozzle which may be opened or closed at will, a stream of compressed air is directed against upholstered furniture, carpets and many such articles that gather dust readily. The effect is a cleaning operation of marvelous rapidity. In this manner are the coaches of a railway cleaned after every trip. In the large cities it is no uncommon sight to see a van drive up to a large office building. From this vehicle is unreeled a hose attached to a compressed air machine. The hose is pulled up through a window on, perhaps, the twentieth floor, and carpets are cleaned on the floor, and chairs, sofas, etc., are renovated.

FOR MOTIVE POWER.

Compressed air serves many other purposes, where power is needed. By it ladders are raised or lowered, elevators and automobiles are operated and engines are run by this means.

SUGAR CANE IN SUGAR MAKING AND PAPER MAKING

SUGAR CANE.

The main development of the cane sugar industry began about 1885, although it had attained large proportions before the Civil War. Originally, the Jesuits brought cane from San Domingo in 1757. The ribbon cane now cultivated, however, was brought from the island of St. Eustatius to Georgia, whence it was introduced into Louisiana. Over 100 varieties of cane are being experimented with at the Louisiana sugar experiment station at New Orleans. But two kinds are commonly cultivated in Louisiana—the Purple or Black Java and the Purple Striped Ribbon Cane, which were introduced about 1825.

AREA OF CANE GROWTH IN LOUISIANA, AND METHOD OF PLANTING.

The area of cane in Louisiana is considerably more than 300,000 acres. From four to six tons of cane are necessary to plant an acre. It is common to plant a few acres, use the entire crop of the next year in planting a larger area, and take the entire crop of the third year to plant the whole plantation.

Several sugar houses in Louisiana work from 1,000 to 1,500 tons of cane daily or

from 60,000 to 70,000 tons during the season of from 60 to 90 days. The cane, which grows best in a sandy loam, does not seed. It produces a crop of 20 to 30 tons per acre. Where used only for sugar, the fodder and tops, the bagasse from the mill and the ashes from the sugar house are carefully returned to the soil. In some localities, however, the waste is being utilized in a new way, as hereafter mentioned.

SUGAR CANE SUGAR ON THE LEVEE AT NEW ORLEANS.

PROCESS OF MAKING SUGAR.

From the field cane is carried to a moving platform which drops it end on into a chute abutting upon a three-roller mill giving two pressures. A conveyor then takes the crushed cane to a second mill where it gets a final squeezing and is ejected in a pretty dry state (called bagasse). This is conveyed by a third carrier to the bagasse furnace, where it is consumed as fuel and supplies steam power and steam heat to the sugar house.

The juice as it runs from the mill is strained and limed and passes into the clarifiers where the temperature is raised and the lighter impurities, coming to the surface, are skimmed off, while the heavier sink to the bottom. The clear juice is then drawn off and sent to the boiling-down apparatus. There it is concentrated into a syrup which is boiled to a grain in the vacuum pan.

SEPARATING THE SUGAR FROM THE MOLASSES.

The contents of the pan are then sent to the centrifugal machines, which separate

the sugar from the molasses and the former is put into barrels. The latter undergoes another process before the final molasses is produced.

PAPER MADE FROM SUGAR CANE.

The manufacture of sugar cane into paper has taken practical form, and mills for this purpose are being erected in various parts of Honolulu.

The advent of crude petroleum for fuel upon the plantations is making it of little value as a fuel. With the coming of the cane paper mill begins a new epoch in the paper trade.

Experiments made with bagasse have proven that paper can be successfully manufactured from it. In the near future sugar-cane paper will be a strong competitor of its rival, "pulp," or rag paper.

PAPER FROM THE PALM LEAF.

In this connection it may be stated that paper is also being made from the palm leaf found so plentifully in the Southern States. Mills are here and there going up and are converting into profit what was once considered a total waste.

By courtesy of the McCormick Division, International Harvester Co.
CUTTING SUGAR CANE, LINCOLN, NEBRASKA.

MINING COAL AND MAKING COKE

MINER, AND CAR "NOT FILLED," According to Operator.

Coal mining is one of the great industries of the world. The recent strike in the anthracite coal regions gave an impetus to coke making that will have a tendency to make this also one of the great industries of the present age.

FATALITIES IN COAL MINING.

Coal mining is hazardous, and the loss of life, by accident, in the mines of the United States averages eight per day. This is not to be wondered at, for, deep in the bowels of the earth, thousands upon thousands of men are working day and night, mining the coal which is an essential factor in the industrial activities of the world.

COAL INDISPENSABLE.

With all the new forms of power that have been devised by ingenious inventors of

ONE OF THE BIG BREAKERS
At Wilkesbarre, Pennsylvania.

late years, it has not yet proven possible to eliminate coal or even greatly to reduce its usage. Electric power, except in those isolated instances where it is generated by a water-fall, requires that great furnaces and boilers shall be employed to produce it. Electric light may partially supersede gas, and thus somewhat lessen coal consumption in this direction, but the coal must be burned to generate the power which drives the dynamos.

The amount of wood burned for fuel has been greatly decreased, owing to the deforesting of large areas, and a greater demand upon the coal bearing regions has resulted. The settlement of our vast prairie states, where cold rules throughout a long winter, has likewise shared in stimulating coal mining. To-day we note the enormous growth of manufacturing enterprises and the extension of railway systems. These alone mean much to the coal mining industry. In days gone by, scientists expressed alarm over the threatened exhaustion of the world's coal supply. And yet it appears true that the economical utilization of coal through improvements in power application, will more than counterbalance the increased consumption of this essential fuel, and after all, nature will preserve a balance in some way.

THE WORLD'S SUPPLY OF COAL.

Everywhere are great fields of coal as yet untouched by the hand of the miner. Siberia and the Chinese Empire are noteworthy examples of this. Petroleum fields, yielding apparently limitless quantities of fuel oil, have been discovered in many parts of the world, and, except on the shores of the Caspian Sea, have hardly been used at all. Texas, the Mexican Peninsula, Lower California, Central Siberia, the East Indies, and the Mid-Australian Deserts, come into this category. Such natural forces, eternal and world-wide as the winds, the tides of the ocean and the heat of the sun, are attracting the attention of great scientists as offering a rich supply of power for man's mechanical use as soon as science finds the way.

Under such conditions as these, thus briefly outlined, it seems a needless anxiety

MINER'S HOUSE,
Near Hazleton, Pennsylvania.

to concern ourselves to-day, with the possible exhaustion of the world's fuel supply in the course of a dozen centuries.

The first use of coal for industrial purposes in England was in the year 1234. After more than 100 years England still leads in the production of coal, being the only country exceeding the United States. in this respect.

OUTPUT OF COAL IN GREAT BRITAIN AND IN THE UNITED STATES.

The annual output of coal in Great Britain is more than 200,000,000 tons, while that of the United States is approximately 195,000,000 tons. Our American mines, being of more recent development, have not penetrated so deep into the earth as some in the old world.

THE TWO DEEPEST COAL MINES.

The deepest coal mine known is near Tournay, Belgium, extending 3,542 feet into the earth. The deepest coal shaft in England is in the Dunkirk mine, of Lancashire, which is 2,824 feet deep.

PENNSYLVANIA'S COAL PRODUCTION.

Pennsylvania leads in the matter of coal production in the United States. Its total product is always more than half that of the entire American yield from all the mines, and exceeds annually 105,000,000 tons. So commanding is this industry in the Keystone State that the popular mind always associates the state with the product, and Pittsburg has gained the name of the "Smoky City" on account of the great manufactories and mines operating in its vicinity.

THE DISCOVERY OF COAL.

Coal was first discovered in the Schuylkill district in 1790. Thirty years later the first shipment was made to Philadelphia. Two kinds of coal are mined, anthracite and bituminous, or, more popularly speaking, hard and soft coal.

AREA OF ANTHRACITE AND BITUMINOUS COAL.

The area from which the former is produced measures less than 500 square miles, and that of the soft coal, nearly 9,000 square miles, but the former excels the latter in tonnage produced, and by its greater value per ton, which is more than double that of the latter.

THE PROCESS OF MINING COAL.

The process by which the coal is mined is an interesting one. Down deep in the earth stands a grimy miner. He is dressed in homespun clothes, and upon his head is a small cap, to which is attached a small lamp. This light throws a faint gleam around him and permits him to see the black walls against which his efforts are being directed. The lamp, which rests upon the peak of the cap of the miner, is the invention of Sir Humphrey Davy, and is so constructed as to prevent explosion.

With pick and shovel the miner breaks down the coal, gradually enlarging the subterranean chamber in which he is working. At stated intervals, giant powder is used to blast out great chunks of coal, which fall around the shaft in great profusion. Miners, in most mines, are compelled to use both vertical shafts and horizontal tunnels, or "drifts," in the course of their operation. If the first opening is in the side of the hill then it will be some time before it will be necessary to sink a shaft. From the shaft the tunnels or drifts radiate in whatever direction the coal measurers lie, and at different levels, so that work may be

carried on in many places at the same time. Tracks are laid in all these tunnels, or "drifts," and on these little tram or dump cars are run back and forth to carry the coal to the surface. When they reach the shaft, they are placed on powerful elevators and brought to the surface of the earth. Horses and mules are used in the United States to operate such cars, but in England women and children are employed to push these cars back and forth. In some places

MINERS, WITH POWDER.

locomotives, operated by compressed air, are substituted for mules and horses.

GUARDING AGAINST FIRE-DAMP.

One of the greatest dangers the coal miner has to guard against is the explosion of fire-damp, which may at any time be set off by a single tiny spark. It would therefore be impossible to use an engine that has a fire-box. The machinery of these engines is different from that of any other locomotives. The air supply is gained from great tanks carried over the driving wheels. These tanks have a storage capacity of 600 pounds to the square inch, from which 200 pounds working pressure is maintained upon the engine cylinders. The supply can be readily replenished with nozzles attached to high pressure pneumatic tubes, placed at points convenient for this purpose.

When the coal reaches the surface, either by tunnel or shaft, it passes rapidly through a series of processes necessary to clean it, sort it into various sizes or grades for the market, and bring it to the railway cars by which it is to be shipped to its destination.

SORTING COAL.

In a great coal "breaker," there is much noise and plenty of dust. There are rickety sheds, inclined planes, screens and chutes, without number. The loaded cars right from the mines reach the breaker high in the air, and are tilted so that they dump their cargo into chutes provided for that purpose. As the coal rattles down through the winding way provided for it, the various chutes sort the grades and sizes, and when it reaches the bottom it falls into bins or coal dumps and is ready for the market.

THE "BREAKER."

In preparing coal for the market, the "breaker-boy" plays an important part, for it is he who stands guard and removes each piece of slate from among the coal. The "breaker-boy," or coal picker, gets his first lessons in mining by sorting out the slate. The miners in many of our mining districts are foreigners, with but little education, and it is this class of labor which forms one of the most difficult problems to deal with.

COAL TRANSPORTATION.

In the transportation of coal from mine to market, many of the great railways find

their greatest revenue. In Pennsylvania, are a number of railroads which control the output of the mines, and it was these roads that, during the strike of 1902, held out so long against the demands of the miners. Hundreds of trains are run daily from the coal fields to the great manufacturing cities of that region.

THE MANUFACTURE OF COKE.

Much of the coal output of the Keystone State is converted into coke for use in steel mills and manufactories. It is thus that the coke furnaces become a part of the coal industry, and they have accordingly grown to enormous proportions.

The manufacture of coke is now in an almost perfect process. The mechanical appliances used have been improved, so that, virtually, all the work from the mine to the railway car can be carried on by machinery. The coke is drawn from the furnaces where the coal has undergone the charring process, by an ingenious mechanism which works like a great iron hand, on the end of a long steel arm. This is carried on a heavy car, which runs back and forth on a railway track, in front of the row of furnaces. An engine mounted on the same car operates the gigantic hand. Afterward, the coke is raked into a long trough, where an endless chain or belt carries the product direct into cars, ready for shipment.

Pennsylvania is in the lead, with a record of being able to furnish half of the total yield of coal for the United States, and practically all of the anthracite. Illinois follows, a close second, with a total of 20,000,000 tons of bituminous coal; and West Virginia is in third place. Other states in which the coal industry has assumed large proportions, are Ohio, Indiana, Virginia, Iowa, Missouri and Colorado.

NEW METHOD OF FATTENING POULTRY

Before entering into a description of the process of artificially feeding chickens, it will be necessary to understand properly the term "fattening." The process is an ancient one. Pliny recorded the fact that the inhabitants of Delos engaged in it, and the luxurious Romans fed and fattened poultry.

POULTRY FEEDING 2,000 YEARS AGO.

The same process was followed in Italy 2,000 years ago. Fattening poultry is a very important industry in England, France and Belgium. In many places, whole families follow poultry fattening as a business. The word "fattening," as used in this connection, is a misnomer. It implies fat or grease, whereas the results aimed at in chicken feeding are directly opposite.

FATTENING GEESE.

In the case of the goose, an abundance of fat or oil is the prime object to be attained. The food necessary to produce this is of a highly carbonaceous, or fat-producing nature; what is termed a very wide ration, has this particular effect. The basis of this feed is corn, which has a special tendency to deposit its fat or oil around the internal organs, as well as in layers under the skin. If the feeding be prolonged a sufficient length of time, it produces an abnormal growth of the liver. This is not desired in chicken-fattening. Layers of fat should not be seen under the skin.

The poultry producers and middle men are awakening to the possibilities in poultry raising, and many new methods of fattening are being tried.

There are two ways of feeding, one by machine, and the other from a trough. The only difference in them is that in the latter, the birds, if left to their own inclination, will not consume half as much as they are able to digest and assimilate, and therefore do not take on flesh so rapidly.

MACHINE AND TROUGH FEEDING.

The machine feeding is a very complete operation, and one that a 15-year-old boy, or a woman, can conduct successfully. The birds are cooped, five in a compartment, 20x30 inches in dimensions, there being a row of 50, or more, of these coops, with V-shaped slats for the bottom, and slat or wire fronts, with doors.

If the chickens are to be fed from troughs, these are hung in front, and after morning and night feeding, are removed and cleansed. In machine feeding, the feeder begins the night before by taking a sufficient quantity of sour milk, or buttermilk, and stirring into it what is known as grenadier meal, until it reaches the consistency of thick cream. This is left to stand over night in order to start a slight fermention, when a diastase is formed that greatly aids digestion.

In the morning the feeder, with a helper to hand him the birds, begins work. As the bird is handed to him he places it under his right elbow, to hold the legs and wings firm, and then opens the mandibles, at the same time depressing the tongue with one finger, to prevent injury. he inserts the tube into the bird's throat. Then, drawing the neck straight, he slides the bird on the tube until, with his right hand on the crop, he feels the end of the tube touch his thumb. He then places his foot on the treadle and gives a slight pressure, when the crop is filled. The quantity is regulated by the age, adaptability and condition of the bird,—one gill being an average for a three-pound bird. This feeding operation is perfectly harmless, and does not cause the birds the slightest pain or inconvenience. On the contrary, they soon learn to look forward to feeding time, the same as if at liberty on the farm, where they all assemble at the usual hour, at the customary feeding place.

This feeding process is repeated morning and night for 21 days, when, after 24 hours' fasting, the bird is killed and dressed for market.

PROFITS IN FATTENING FOWLS.

The profits the fattener can expect to make are easily figured and are based on existing conditions. A three-pound bird, as it comes from the farm in August or September, usually sells for from 25 to 30 cents in the West, say 30 cents. This bird carries about six ounces of bone, and 18 ounces of offal, and after cooking, has 13 ounces of edible meat. Special feeding for 21 days at a cost of eight cents for feed, turns it out a five-and-a-half-pound bird, and now it carries 40 ounces of edible meat. If sold at the same price per pound paid for the common carcass, it would bring 35 cents, or quite a handsome profit on a three weeks' investment. There is no occasion, however, for selling it at any such price. There is an abundance of discriminating buyers who will gladly pay a good advance for fancy stock. In any event, the buyer is willing to pay as much per ounce

of edible meat in the finished bird as in the thin one, if not more. In that case he should pay 92 cents for the bird. He would then be getting precisely as much for his outlay as in buying the thin bird.

This rule applies to all farm animals. The first question the butcher asks is how will the animal dress? What is the percentage of meat to offal? Where this is not considered, economy is not practiced.

IRON AND STEEL MANUFACTURING

America, with its great mountains of iron ore, furnishes most of the steel of the world for bridges, high office buildings, railway rails, wire, and the manifold forms of steel and iron which, commercially bring thousands of dollars to the manufacturers. Let us see how crude iron ore changes its shape and quality at the hands of man.

THE CUPOLA MAN.

In an iron foundry the "cupola man" or "melter" is a person of considerable importance, for he "makes" the iron, and the presence of more or less of this or that metalloid in his pig iron, too much sulphur in his coke, too little air coming through the blast-pipe, or a heavy atmosphere, are circumstances beyond his control, which may turn all his plans to naught.

THE CUPOLA.

The cupola is the vertical, cylindrical-shaped furnace, in which the iron is melted from "pig" or scrap, to be cast in the sand molds, into all of the different forms and shapes taken by cast iron. The real bottom of the cupola is made of sand, and this sand bottom rests on a false bottom which is made of iron, and so swings on heavy hinges that it may be dropped, emptying the cinders on the floor of the foundry. This false bottom is held in place by a heavy piece of wood, which stands on the solid foundation that supports the legs of the cupola. The "tap-hole" of the cupola is the opening through which the molten metal runs into the "spout" and then into the ladle. It is generally about four feet above the floor of the foundry, for it must be high enough to clear a large ladle, to catch the iron. In the back of the cupola is the cinder hole. This hole is used to tap the cinder and to give the alarm should the molten metal rise to the "tuyere" line.

THE TUYERE.

"Tuyeres" are the openings for admitting the air blast into the cupola, and they are generally placed high enough from the bottom to give a bed of molten metal, weighing from 1,500 to 2,000 pounds. The air, driven by a revolving fan, is carried

DRIVING NAILS BY MACHINERY.

to the cupola through the blast pipe. Around the base of the cupola and on a line with the tuyeres, is the "wind box," which carries the blast to the tuyere openings. The "charging floor" is a platform on which the coke, pig iron and scrap iron are piled, and on which the men stand when charging the cupola. The pig iron is usually broken into short pieces to facilitate handling, and to expose more surface to the heat.

By courtesy of the Detroit Photographic Co.
UNLOADING ORE AND LOADING FUEL, LACKAWANNA ORE DOCKS, BUFFALO, NEW YORK.

CHARGING THE CUPOLA.

To charge a cupola is to place in it alternate layers of fuel and iron. Before charging, however, the cupola must be heated, and a fire of coke is started. The cupola man places on the bottom of the cupola a bed of coke and, frequently, a certain proportion of hard coal in large lumps, with the coke. This bed is placed there as a reservoir, and is supplied, at intervals between charges of metal with fresh fuel. When this bed is burnt through and the cupola is heated, a fresh amount of coke is thrown in through the charging door, and then a layer of pig iron, or a layer of pig iron and scrap iron, in varying proportions, is put on the coke. More coke is then thrown on top of the iron and then another layer of metal is put in, and these alternate charges of fuel and metal are put into

the cupola until it is full. Then the blast is turned on. When the iron becomes heated it gradually melts. There is a peephole, through which the cupola man can see when there is a quantity of molten iron, and when there is enough the tap-hole is opened and the liquid metal, throwing off a shower of sparks, flows out into ladles, to be poured into molds. The ladles vary in capacity from 50 pounds for the smaller ones, to 12,000 pounds for the big clay lines,—"bull" ladles,—which are handled by traveling cranes and machinery.

CHEMICALLY PURE IRON VALUELESS.

Chemically pure iron is of no value to the foundryman, and it is of most use when mixed in certain quantities with metalloids such as manganese, carbon, silicon, sulphur and phosphorus. Carbon should exist in iron mixes to about 3 per cent. Sulphur should be present in very small quantities, and when there is too much in the mix, lime is mixed with the iron and coke in the cupola. The limestone takes up the superfluous sulphur, and renders the iron more fit for molding.

MAKING PIG IRON DIRECT FROM THE IRON ORE.

In making pig iron direct from the iron ore, much the same principle is used as just described. In that work, however, the ore, limestone and coke are placed in the cupola instead of the iron refined. When the supply of molten metal in that case is sufficient for a flow, the plug is knocked out of the tap-hole, and the molten metal runs out into a sand floor into "pigs." The sand floor has been prepared in long troughs, not unlike plowed furrows, and when the hot metal has been run into them the sand is thrown over the top to help congeal it. In order to make the pigs in a form that can be handled readily, workmen walk about over the top of this hot bed of metal, their feet protected from the heat by great wooden shoes, or blocks of wood tied to the shoes, and with long handled hammers, strike the bars of cooling metal, breaking them up into convenient form for shipment.

STEEL ROLLING.

Sometimes the pig-iron mill is adjacent to the steel rolling mills, and in that event it is desirable to roll the metal while it is yet hot and thus save reheating. This is done by taking the liquid metal in little brick or clay line-carts or ladles to the great steel mixing blasts. These are like immense cupolas without any cover. The iron is poured into these great upright cylinders, with a quantity of "spiegel iron." This is a combination of metalloids mentioned before, being principally carbon, to give a certain quality of brittleness. The more carbon is mixed with iron, the more brittle it is. When the mix is proper and the combination has been blasted by a fierce blaze, it is run off into great ingots. When these ingots have been cooled a little, but are yet very hot and red, they are carried about through the different processes of manufacture. If it is steel rails that are to be made, the ingots are thrown into great series of heavy rollers, which reduce the width and thickness of the billets but lengthen them out and shape them properly. By the time the steel is cool, they are straightened and complete for doing their part in great railways for the transportation of the world's products.

SILK COCOONS, AND THE SILK INDUSTRY

The illustrations in this article are furnished by the courtesy of Belding Bros. & Co.

The art of reeling, or producing raw silk, has been carried on in China for ages, and so well did the orientals guard the secret of silk culture that the nature of the fibre was unknown in Europe for more than a thousand years after silk fabrics had been introduced there. China still takes the lead in the production of raw silk; but large quantities also are obtained from Japan, India, France and Italy. Every silk article ever made or exhibited was originally in the cocoon condition, and the fibre had to be put through a great variety of processes before it was finally ready to be woven into fabrics. The idea is quite common that the silk threads or fibres as they come from the cocoon are ready for the weaving loom without further work or preparation, but the fibres, after coming from the cocoon, must be manufactured before they can become of any value.

FEEDING THE SILK WORM.

THE SILK MOTH AND THE SILK WORM.

The little bright colored silk moth deposits from 400 to 600 eggs, and then disappears and soon dies. The eggs, on being exposed to a temperature of 65 or 70 degrees, hatch rapidly, each one producing a short brown worm, which, with a ravenous appetite, feeds upon the leaves of the mulberry tree, consuming double its weight daily. In five weeks, it attains its full growth, having increased 8,000 times in weight. It is then three inches long, and as thick as a large, lead pencil.

THE SILK COCOON.

The worm now seeks a convenient place to begin the formation of its cocoon, which is to protect it in the changes incident to caterpillar life. Having selected a site, it ejects from two small tubes near the mouth, a liquid, gummy substance which adheres to whatever may be within reach; thus anchored, the next move of the body in the opposite direction draws out the silked fibre. The worm then turns over and over toward the center of the cocoon, and pays out the silked cable as it goes, until it has spun itself almost to death, and has built

COCOON—END VIEW.
(Enlarged.)

around itself a cocoon of silked thread about a quarter of a mile long.

Thus imprisoned, the insect remains, if undisturbed, for about 15 days, when the end of the cocoon is moistened, and it emerges in the form of a moth. This, however, causes the fibre of the cocoon to be badly tangled and twisted, so that it is necessary to kill the insect before it comes from the cocoon. This is done about eight days after the cocoon has been finished, by exposing it to the direct rays of the sun at a temperature of 100 to 125 degrees.

REELING THE COCOON INTO RAW SILK

The cocoons are now ready to be reeled into raw silk. This is a very important operation, as everything depends upon the reeling, and the quality of the silk will be good or bad, according to the manner in which it is done. In silk countries the making of the cocoons is carried on as a separate business, distinct from the raising of silk worms, the cocoons being sold outright to the reeling establishments, which are known as "filatures."

If the reeling has been indifferently performed, the silk may not sell for more than $4 a pound, but if well reeled it may bring $6 to $7, and even more, depending upon the demand at the time. It is also a peculiar fact, that of two reelers, each reeling half a pound of cocoons of the same quality, one will be able to obtain but 6 or 6½ ounces, and another will obtain 8 ounces.

The filaments of the cocoon are cemented together with a gum, and to dissolve this gum requires the aid of hot water. The cocoons are placed, from 6 to 10 at a time, in a basin of hot water, and sunk by the aid of a whisk broom below the surface, where they are allowed to remain from two to three minutes. This softens the gum and loosens the fibre; then, moving the whisk broom very lightly over the cocoons, the ends of the fibres will adhere to it and are easily found.

The ends of the fibres from each cocoon in the basin are then collected together to form one thread, which is passed through a

MOTH.

RAW SILK.
First Process, Winding.

guide eye and tied to one of the barbs of the reel, and the reeling begins.

The reels are usually turned by hand, although, occasionally, electric power is used. The reel must be so far away from the basin that the gum of the fibres has a chance to dry and cool before it passes onto the reel, otherwise the fibres would become firmly cemented together. It is also important that the reel should be moved at a certain uniform rate of speed. The whole operation is tedious and necessarily expensive, as five ounces of well-reeled silk represents about ten hours' labor by an expert reeler.

The reels are usually about 70 inches in circumference and have a traverse rod which properly distributes the thread over a surface two or three inches wide. So fine are the fibres which come from the cocoons that they are almost invisible to an inexperienced eye, and the reeler does not depend upon seeing them, but gets notice of a broken subdivision by discovering one of the cocoons at rest on the water, while the others are still in motion.

This rupture must be instantly repaired if a uniform thread of raw silk is to be obtained. A supply of cocoons is kept close at hand so that as fast as the fibre in one is exhausted, another is put in its place. The ends are joined by a dexterous movement of the reeler, who carries the end of a reserve cocoon fibre to a point just below the guide eye, where the natural gummy substance found on the silk, assisted by the movement of the reel, causes adherence to the main thread.

Thus no tying of knots takes place in a single fibre of the silk while reeling, although in case of a break in all of the fibres, which is not common, a fresh start must be made, and a small knot is made, hardly perceptible in the after stages which the silk passes through. The skeins of raw silk are reeled from one to several ounces, as desired, and, on being removed from the reels, are dried and neatly packed into books or bundles weighing from 5 to 10 pounds. These books are then packed and sold in bales containing 133 1-3 pounds each, which is the way in which the raw silk reaches this country.

DYEING SILK.

THE TWISTING PROCESS.

SPINNING IN THE FACTORY.

On reaching the factories where the manufacture of this raw silk is carried on, the skeins are soaked in tepid soapsuds for several hours to soften the gum, after which they are placed on light "swifts" and wound off onto bobbins. This makes the raw silk soft and pliable and gives a certain lustre to it. These bobbins are placed upon pins projecting from the bobbin board of a doubling frame, and from two to ten threads, or even more, are drawn off collectively onto one bobbin, which is next placed upon a rapidly revolving spinning-frame spindle. The threads, while being drawn from the bobbins to the spindle, are given the requisite amount of twist. These spindles revolve so rapidly as to appear to be motionless, a speed of 10,000 revolutions a minute not being at all unusual.

The thread is now drawn from the spindles and doubled and twisted, and for some purposes is again doubled and twisted, so that in an ordinary three-cord sewing silk it is quite possible to have 200 or even more of the original, gossamer threads which came from the cocoon, and the lightest grades of thread contain, at least, from 75 to 80 of the fibres.

DYEING AND SPOOLING THE SKEINS.

The next operation is reeling the silk into hanks of skeins for dyeing, which is one of the most important of the various processes, and requires experience as well as knowledge. After being dyed the thread is wound on spools, as desired, this operation being performed with great rapidity and accuracy by automatic machinery.

The silk cocoons vary in color from a delicate white to a dark yellow, depending to a great extent on the food of the worm and the locality in which it grew.

WEAVING SILK.

BEET SUGAR AND ITS COMMERCIAL VALUE

SIGNIFICANT FIGURES PROMISING GREAT RESULTS—THE GERM OF A STUPENDOUS INDUSTRY.

The United States imports yearly an amount of sugar valued at $100,000,000. Every fifteen years this quantity is doubled. We gather the following figures in this connection from a work entitled the "American Sugar Industry:" "Taking the imports for 1895-6, say 1,720,000 long tons annually, to produce this quantity would require 920 factories, each working up 350 tons of beets during a campaign of 100 days of 24 hours. Each factory would need 2,000 to 2,500 acres of beets, or about 2,000,000 acres in all. As the crop should only be grown on the same ground every third year, three times as large an area would be needed.

GREAT GAIN FOR THE FARMERS POSSIBLE.

At an average of only ten tons per acre, the total crop would approximate 20,000,000 tons. At only $4 per ton net for beets delivered to the factory, the farmers would receive $80,000,000 for this new crop.

COST OF A BEET SUGAR FACTORY AND EXPENSE OF RUNNING.

Each factory would cost about $350,000 —in all over $300,000,000. For running each factory, the cost of labor and materials, aside from beets, would be about $500 per day during the season, or $50,000 for the whole period, making the annual distribution for labor and materials about $45-000,000.

DISTRIBUTION OF WEALTH THROUGH THE BEET SUGAR INDUSTRY.

Each of these 900 sugar mills means the yearly distribution in its immediate vicinity of $150,000 to $200,000, for 30,000 to 50,000 tons of beets; $50,000 to $75,000, for factory labor and supplies; $10,000 to $25,000, for repairs, salaries, etc.

The profits and reserves remaining would be from $25,000 to $75,000. Under average conditions it is safe to calculate on a yearly turn over by each factory equal in amount to its capital. The factories at Watsonville and Salinas, California, represent an investment of from $1,000,000 to $3,000,000 each, and from them the farmers will receive $2,500,000 yearly for the necessary supply of beets.

When the sugar beet was first cultivated in the late "seventies," other crops paid better. The first factories were not well located, the beets were of poorer quality, and the price of wheat was high, making it more valuable to cultivate than beets.

Then 11 per cent of sugar beets was considered a fair average. Now the average is from 14 to 15 per cent, and from 18 to 24 per cent has been shown in tests. In 1884, the world's production of beet sugar was 2,500,000 long tons. Since 1892, the average yearly production has almost doubled. In 1898, nearly two-thirds of the sugar consumed in the world came from beets.

SUGAR BEETS A PROFITABLE CROP.

An acre of corn at the West yielding 40 bushels of grain, worth 15 cents a bushel. will buy about 100 pounds of granulated sugar at the grocery. The same acre, devoted to sugar beets, will produce 2,000 to 3,000 pounds of refined sugar. Sugar beets yield $25 to $50 per acre, and leave a net profit of $10 to $25 per acre.

NEW INVENTIONS IN FLOOR COVERINGS

MATTING.

Emile Berliner, the inventor of many electrical and mechanical devices, in experimenting with the matting on his floors, found that the dust filtered through it in a short time, and that if a break occurred it was almost always necessary to recover the entire floor. To remedy these defects, he conceived the idea of cutting the matting into small squares or other designs, and laying them like parquet. The inventor took ordinary Chinese or Japanese matting and backed it up with linoleum paste, which has a tendency to strengthen the fibre. The squares were then pressed on heavy cardboard, after which they were laid on the floor and fastened with a few tacks. A coat or two of varnish was then added, which enhanced the brilliancy of the pattern, and made it possible to rub the floor with a damp cloth when it became dusty. As one square wears out, it can be easily removed and a new one inserted.

LINOLEUM.

Waste cork, from the big factories, that turn out the various products of this material, is utilized in the making of linoleum. Perhaps the greatest linoleum manufacturing center in the world is Delmenhorst, Germany, which town is also the greatest cork center of Europe.

PAPYROLITH.

An innovation in the construction of floors was invented by one Otto Kraner, of Chemnitz, Germany, in 1896. It was a special preparation of paper pulp which the inventor called papyrolith. It was prepared as a dry powder, which was to be mixed with water. When this mixture was spread on a foundation of stone, cement or wood, it dried in a short time, after which it was planed and polished down to a smooth surface. The wearing qualities of a floor of this description are said to be remarkable. Some of the chief advantages claimed for papyrolith were the facts that it was solid and left the floor without a crevice; that it was a non-conductor of heat, and possessed a tendency to deaden noise. It was also said to be almost fireproof.

Papyrolith never gained a foothold in the United States.

CARPETS FROM NEW RAGS AND REMNANTS.

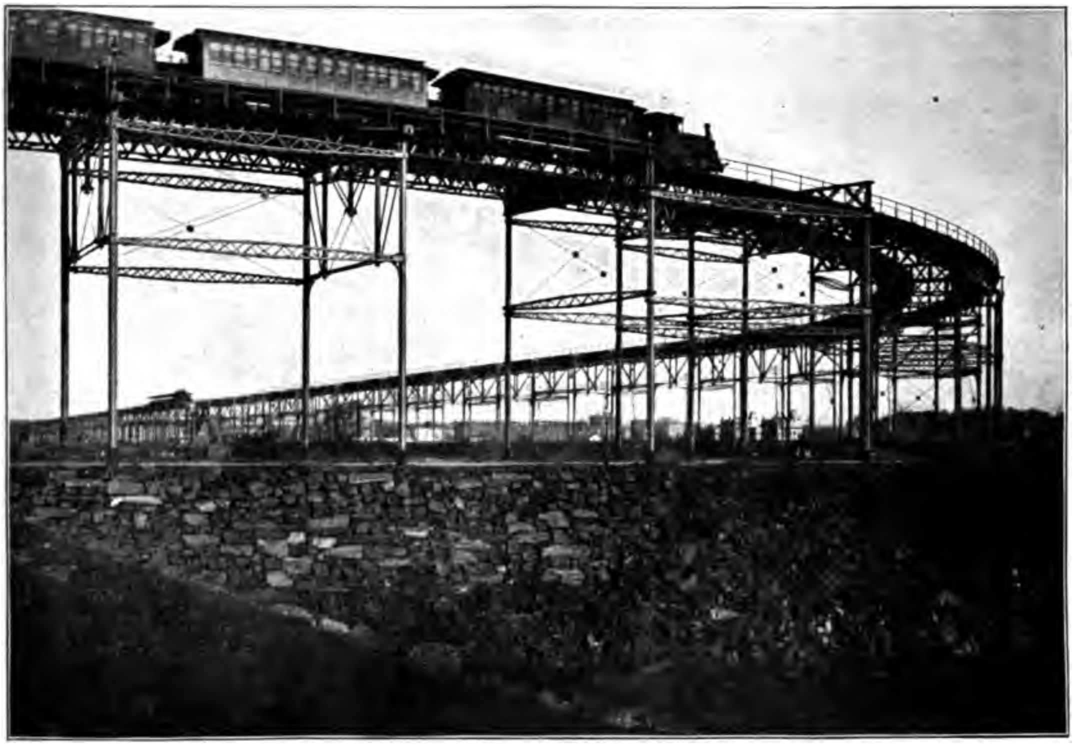
There is a large concern in Pennsylvania which makes carpets from new rags and remnants. This firm gathers its materials from the big cotton weaving mills and from the large jobbing houses throughout the country and they are woven into carpets that sell for a good price. This carpet is woven in the same manner as the old-fashioned rag carpets, and the remnants after being cut into strips are sewed together by the country folk of the neighborhood about the factory. Some of these carpets are made in solid colors and the effect is excellent. On account of the rags being entirely new and strong, this texture is often as durable as the old time rag floor covering.

ORIENTAL CARPETING.

Undoubtedly the star innovation in carpet floor covering was that made by Frank F. Hodges, who was originally a manufacturer of straw goods in Boston, when he

tried to introduce in 1892 a fabric which he termed "Oriental carpeting." This fabric was woven to all intents and purposes after the manner of ordinary carpeting, but instead of the warp being of wool or jute fibre, it was made of twisted tissue paper. The opposition which this fabric met in the beginning was exceedingly strong and persistent, but after years of laborious and expensive experimenting, Mr. Hodges was able to produce a fibre from which he has since successfully made rugs and carpetings which were durable, sanitary and very sightly.

ELEVATED RAILROADS



THE GREAT CURVE OF THE NEW YORK ELEVATED RAILROAD.
At its highest point, 116th Street and 8th Avenue. A steel structure upholds the track.

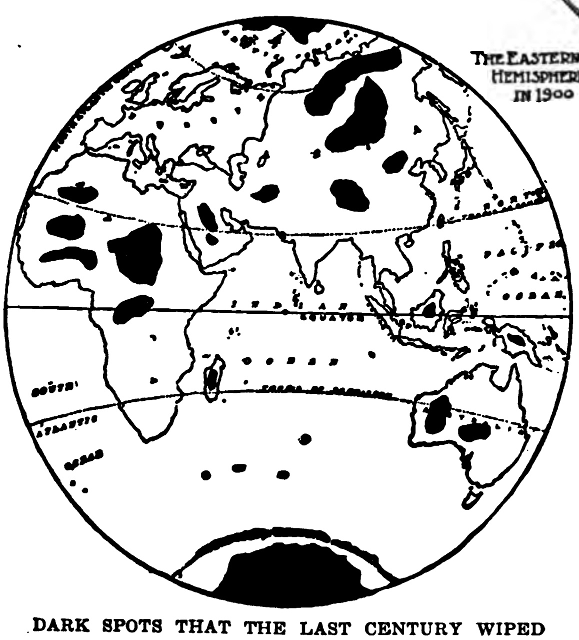
Among the means contrived within a recent period for facilitating urban travel, the elevated railroad is not the least important. Elevated railroads are most popular in the United States, tunnel railways being the more common means of intramural conveyance in the large cities of the old world. The latter method has recently been introduced, however, in New York, and will doubtless soon be in vogue in Chicago and other large cities. The first elevated railroad in the United States was built in New York, in 1875. At present a large proportion of the passenger traffic within the respective limits of both of the above-named cities is conducted in this way. Four extensive lines are in operation in Chicago. What effect the advent of the tunnel system will have on these enterprises is a problem for the future to solve.

BOOK III

VIVID ARRAY OF FACTS CONCERNING DIFFERENT NATIONS

Objects Famous the World Over—Impressive Scenes Far and Near—Peculiarities and Products Distinguishing Widely Separated Localities

THE nineteenth century is notable for two phases of geographic research, which excels any of its predecessors. To-day the whole of North America, south of sub-arctic latitudes, has been carefully explored, and the 13 large areas in Northern British America, to which Dr. Dawson referred as unknown, some ten years ago, have passed out of that category or been greatly reduced in size by such work as Ogilvie has done on the upper Yukon, Low, in Labrador, and the Tyrrell Brothers, in the Barren Lands.



DARK SPOTS THAT THE LAST CENTURY WIPED OFF THE EARTH.

Charts showing what the world did not know about geography in 1800; what has been discovered and what is still in doubt.

Next to Europe, North America is the best explored part of the world, although less than 60 years ago, more than half the continent was not so well known as most of Africa is to-day.

It is only a question of time, when all the habitable territory of the United States and Canada will be as thoroughly studied and mapped as that of European states.

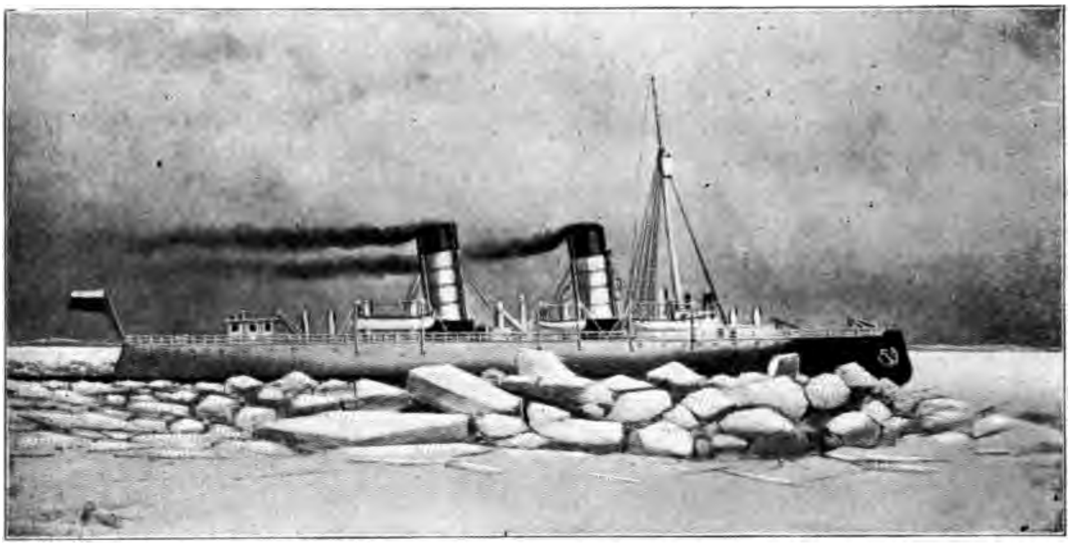
VOLCANOES IN CENTRAL AMERICA.

That Central America still offers a large field to the explorer is shown by the fruitful work of Carl Sapper, who in his notable journey in recent years, has added to the map 81 volcanoes, of which 23 are still active. The long,

gentle slopes from the Central Mountains to the eastern coast of Central America, continually drenched by the Trade Wind rains, have a luxuriant and almost impenetrable vegetation and are still very little known.

SOUTH AMERICA.

Most of the additions which the nineteenth century made to South American exploration are the work of European and North American explorers, many of them poorly equipped and paying their own way. Their most conspicuous service has been the mapping of the drainage and exploration in the northern and central parts of the Cordilleras.



PLOWING A PATH TO THE POLE.

Quadruple Screw Ice-breaker "Errnack," crushing her way through field ice. This unique craft is an enlarged copy of an American lake ice-crusher, and was built by Armstrong, Whitworth & Co., for the Russian government, with the object of keeping the harbor of Kronstadt free for navigation during the winter. Her success in the work prompted an attempt to reach the North Pole under Admiral Manakoff.

THE AMAZON AND LA PLATA.

The Spaniards long ago revealed the courses of the Amazon and La Plata, but they paid little attention to smaller streams and tributaries. It was left to this century, and particularly to the last three decades, to explore these rivers, and we now have an excellent idea of all the large features of the drainage system of that region.

ECUADOR.

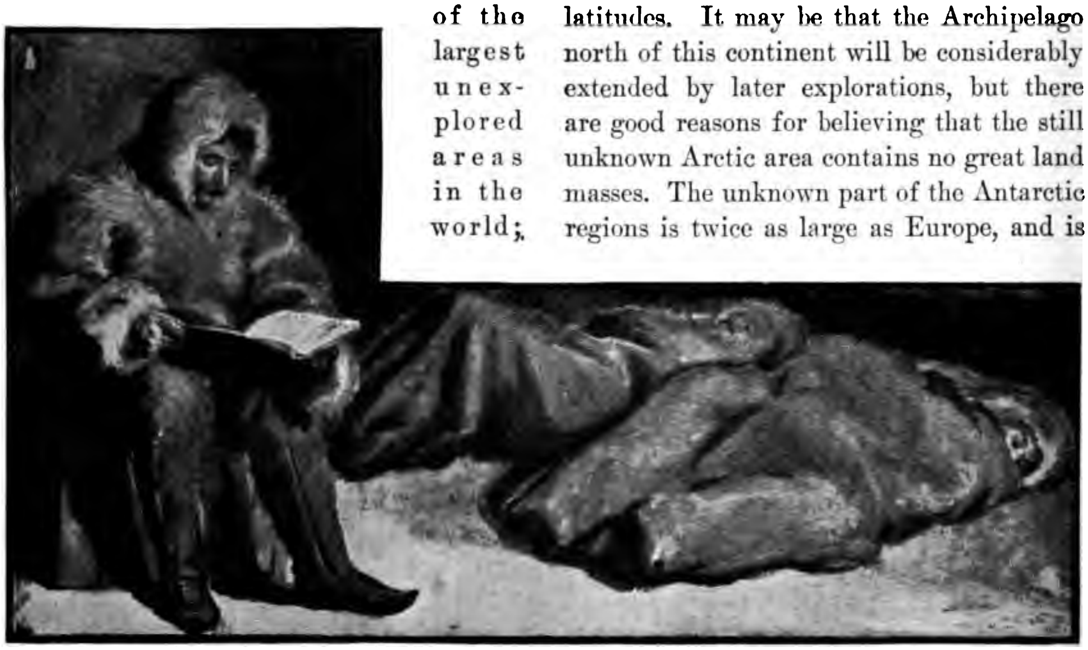
European explorers have made Ecuador better known that Colombia simply because they have been attracted to the Ecuadorian Andes as a specially inviting field. Political or military influences have mainly invited exploration, so far as the states have participated in it. Thus the important wars, that Argentina waged, in 1879 and 1880, with the Indians of the South, and in 1884-1885, with those of the North, had the incidental result of making large parts of Patagonia and the Gran Chaco fairly well known.

ARGENTINA.

Explorations in South America are of very uneven merit. Many are only crude route surveys. Argentina is, by far, the

best mapped state for its geological and meteorological departments, and the staff of foreign professors in the higher schools placed exploration and mapping, after 1882, on a high plane. The Brazilian government has never promoted scientific exploration, and all official work in that line has been done by a few states, mainly by Minas Geraes, Sao Paulo, and Para. Most of the far interior, away from the rivers, is still unknown. The Amazon basin is one of the largest unexplored areas in the world; for, although steamers sail regularly on the main stream and its many tributaries, the stretches between the rivers have not been visited. The inland parts of the Guianas and of the Cordilleran states from Venezuela to Bolivia are still in the crude and early stages of exploration.

A hundred years ago the world knew little or nothing of Africa and had knowledge only of its coasts, Egypt, some of the Barbary Coast lands, bits of Senegambia, and the upper Niger. It was indeed the dark continent.



DURING THE LONG ARCTIC NIGHT.

THE POLAR REGIONS.

In Polar exploration, the nineteenth century did not excel that of former centuries, although it has added many new islands to the maps, attained the farthest point north, and, what is perhaps most important, has perfected the art of living and traveling in comparative safety in the high latitudes. It may be that the Archipelago north of this continent will be considerably extended by later explorations, but there are good reasons for believing that the still unknown Arctic area contains no great land masses. The unknown part of the Antarctic regions is twice as large as Europe, and is now the largest unexplored area in the world.

Every Arctic expert now believes that the attainment of the north pole is only a question of time; and it is probable that the century just opened will fully complete explorations of the entire world, which the century lately closed so wonderfully advanced.

The directors of the Baldwin-Ziegler expedition, which recently returned, report

that they succeeded in getting nearer to the pole by at least 400 miles than any previous explorers; but still they did not succeed in reaching the much coveted goal.

RAILROADS IN THE UNITED STATES

THEIR AGENCY IN DISTRIBUTING WEALTH.

Railroading holds a position of importance in the United States which few people realize. As great distributers and circulators of wealth, the railroads of the United States which, in 1902, were 204,787 miles in extent, are absolutely unexcelled.

In the popular mind a railroad corporation is always associated with the idea of abundant means. There are not many, however, who pause to calculate the part the various railroad systems play in the economic affairs of the country.

DINING ROOM ON THE PENNSYLVANIA LIMITED TRAIN.

GROSS RECEIPTS OF ALL THE SYSTEMS.

When it is realized that during the year 1901 the gross receipts of all the systems amounted to $1,589-526,037 some slight idea can be had of the enormous activities which their operation represents. Of this amount enough was available after paying operation expenses to devote $156,746,536 to dividends, and leave a balance of $87,764,781 to be carried to the surplus account. This available fund was enough to give almost every man, woman and child in the United States $3.

OPERATING EXPENSES.

The operating expenses amounted to over $1,000,000,000. That colossal sum was distributed among the multitude of employes, among the various factories which provided equipment, and among the different interests which furnished supplies. In other words, the railroads expended throughout the country enough to give every man, woman and child about $12 apiece. That one item alone gives some slight idea of what splendid distributers of wealth the railroads are.

NUMBER OF PASSENGERS CARRIED.

These immense sums were earned by transporting 607,278,112 passengers, and 1,089,226,440 tons of freight. The list of

passengers is equal to the population of China, the United States, the British Isles, and France and Germany combined. If the freight total were reduced to men, putting the average weight of man at 150 pounds, it would be equivalent to 145,229,686,000 men. In other words, the tonnage weight of freight for this one year very largely exceeded the combined weight of the entire population of the globe.

These few figures will afford the reader some glimmering of the work accomplished by our various railroad systems. Everybody feels the effect of their operation, and everybody gathers benefits from their activity. There is no other line of enterprise in our country which involves so much capital, so many men and such a tremendous aggregate of general business.

THE CONSTITUTION AND GOVERNMENT OF THE UNITED STATES

Since the birth of man there has been government of some form. Certain lines of conduct have been laid down for the individual, the family, the city and the country,—yes, even for the family of nations. These rules of conduct, or laws, differ as much to-day, possibly, as at any time in the history of the world. We still find government of the selfish order, where the town, family, or even country, is ruled for the benefit of the few. In the main, however, the great benevolent idea of the

THE SENATE CHAMBER, IN THE CAPITOL, WASHINGTON.

brotherhood of man has penetrated to most corners of the world, so that the dominating principle of civilized peoples is that the benefits of the few must be subordinate to the welfare of the many. And yet, there exist, practically, all forms of government, from the crude barbaric up, through despotic autocracy, to wisely self-governing systems of rule. By observing the present governmental methods of all nations, one discovers a page out of almost every epoch of history. He finds the savage with his revolting ideas of family ties, the nomadic hordes, not unlike the Israelites of old, the despotism of the orient, the powerful yet narrow civic life of Russia, with its inane curb on public speech and the press, and the highest type of self government, in England and the United States. Let us look more closely into the methods of governing the different peoples of the world.

Contrary to the general impression the government of the United States of America is not founded on an instrument so marvelous as some people would think. The constitution of this country was by no means the inspiration of the brains of one set of men wrought to an excessively patriotic pitch by the exigencies of trying times. This idea should at once be eradicated from the minds of those who think this great civic document was turned out at white heat in a flash. Nothing is farther from the truth.

THE HALL OF THE HOUSE OF REPRESENTATIVES.

Great as the constitution is, it was considered far from perfect at the time of its drafting. The downtrodden people of the thirteen colonies that struck for independ-

ence had long been gradually working out the measures of just such an instrument, in their daily life. Many of them, driven from their mother countries by persecution, to enjoy freedom in America, found an enveloping mass of restricting laws. Individually, many of the people sought concessions from the different countries which ruled them, as the years went on. Grants of public lands to colonists generally conceded something of democratic government. So did the charter of the colonies from the English crown, as England gradually gained control over most of the new world. In spite of restrictions, the people at large fought hard for their democratic principles. Ideas were at variance in various districts, but in the main the aim was toward something more near to self-government. The colonists insisted on councils from their number to confer with the crown-appointed governors, and held religiously to the right of their town meetings. Such incidents as the hiding of the charter in the old Charter Oak mark the spirit of those times. Naturally, this spirit, these experiences, the charters, town laws, petty constitutions, etc., would have an influence, great indeed, upon the framing of a document on which the federation of states was to be established. Such was the case. Discussion at the time of the constitutional convention, called in 1787, was rife. Many present clauses in the great constitution of to-day were called "royalistic," toryistic and anything but democratic. The papers of that day discussed at great length propositions for the embodiment of certain features in the instrument. When the body of men who framed the constitution had completed their work, it was far from being what some of them had hoped for. In the end, it was a mass of concessions, paring here, curtailing there—in short an excellent document, but only such an one as was simply the outcome of the experience of the people. This was marked by the manner in which some of the states hesitated about becoming parties to the agreement under the constitution. Yet so well thrashed out was the experience of our forefathers that the constitution has withstood assault or change except in but few particulars. And yet again, these few changes, such as the first ten amendments, commonly called the bill of rights, attest the spirit of democracy, concession and compromise, which brought forth the instrument.

CONGRESS.

The constitution is the highest law of the land. By its provisions the government of the United States is divided into three main branches—legislative, executive and judicial. The first has to do with the making of the laws for the United States as a whole. It is divided into two houses, the senate and the house of representatives, known jointly as Congress. The upper house is made up of a body of senators, two elected from each state, in such manner that one-third of the entire body is chosen every two years. These senators are chosen by the legislatures of their respective states, save where appointments are made by governors, to provide for emergencies when legislatures are not in session. Thus it will be seen that the senate represents the dominant party in the various states, and only indirectly is the servant of the people. The senate is an extremely conservative body, and acts as a salutary check against hasty legislation. Yet so widespread is the feeling that this

MEN ON PENNSYLVANIA AVENUE WATCHING THE TIME BALL ON THE NAVY DEPARTMENT, WASHINGTON.

Man in Naval Observatory touching the clock which makes the ball on the Navy Department fall and gives the time to all America by Western Union Telegraph. The ball falls at noon each day.

body is not truly democratic, that constant efforts have been made to elect its members by popular vote.

The house of representatives is a much larger body, being made up of representatives elected directly by the people of the congressional districts of each state, according to population. These members serve two years.

The two houses of congress are largely co-ordinate in their powers, although bills for appropriations can be introduced only in the lower house, while the senate has the power of ratifying treaties and appointments made by the president.

The executive branch has for its head the President of the United States. His term of office is four years, and while in general intent he is the popular choice of the majority of the people of the country, yet the manner of his election by the electoral college sometimes frustrates this idea. In voting indirectly for a president, the people of each state choose a number of electors equal to the number of representatives and senators of that state. It is the duty of these electors to meet at the capitals of their respective states, on a day appointed by law, and to cast their votes for their choice for president and vice-president. These votes are sent to Washington and counted. The men receiving the highest number of votes are elected to the two highest positions of the land. This method, in 1889, resulted in placing in the presidential chair Benjamin Harrison, when, as a matter of fact, the total count of the ballots of the whole country favored Grover Cleveland. Legally, placing an electors' man on a party ticket does not bind him to vote for any particular candidate, and while cases are known where men have violated their party faith, custom rules otherwise.

The President's duties are to enforce the laws of the land, to initiate legislation by sending a message to congress each term suggesting needed reforms, and to veto or approve new enactments. As the leader of his party, he is generally the dominating influence with the majorities of the two houses of congress. His veto power effectually nullifies any given legislation unless overruled by a two-thirds vote in both houses. He is the commander-in-chief of the land and naval forces of the United States, and is accorded as much deference by foreign powers as the ruler of any other nation. In aid of his administration several departments were created—the departments of state, war, navy, treasury, the interior, agriculture, postoffice, and justice, the heads of which make up his cabinet. These men are his closest advisers, chosen by him with the approval of the senate, and, as specified in the constitution, are in line of succession to the presidency, in case of the accidental removal from office of the president and vice-president. These men undertake directly to manage the machinery of the several business departments of the government, such as the coining of money by direction of the secretary of the treasury, the management of the postal service by the postmaster general, etc. They are directly responsible to the President for their acts, and censure or request for resignation would lead to their relinquishment of office, although this is not compulsory, except on the demand of the senate. These men, besides conducting the departments of which they are the heads, serve a great purpose in being the frequent advisers of the president. Di-

rectly responsible to the President, or to the heads of their respective departments, are the numerous employes of the United States government.

THE JUDICIARY.

The judicial department consists of the supreme court of the United States and its subordinate tribunals, which are entirely independent of the other two branches of the government, although co-ordinate with them. It is the business of these courts to determine the construction to be placed on all laws framed by the federal Congress, and on laws made by states and cities of the Union which may conflict with the constitution of the United States or laws made under it. The district, circuit and appellate courts take up certain phases of judicial work for the federal government. If laws are deemed unjust or unconstitutional, these courts are appealed to for interpretation. While it is not the policy of the judiciary to set at naught the laws framed by the legislative department, or the acts of the executive, yet such action has many times been necessary, and thereby the system of checks and balances has been preserved between the three branches of the government. The president needs Congress to pass beneficial laws; Congress needs the approval of the executive to make its laws effective; and then the judiciary determine the validity of the triple legislation. So much for the organism of United States government.

UNITED STATES SUPREME COURT IN SESSION.

From the working of these co-ordinate branches, the constructions put upon the constitution and general enactments has sprung a body of laws. The fabric of these

laws is the result of experience throughout the states and municipalities of the country. It should be borne in mind that the law of the land is divided quite markedly into three divisions: municipal law, which may be said to govern nearest home, in the towns and cities; state law, which is not effective outside the state and constitutional or federal law, which is law enacted by Congress, and is based on the constitution of the United States. Although the last of these is the highest in point of authority, when authority is in question or there is a conflict of authority, the first in some respects is the basis upon which the others have been worked out, and consequently should be treated first.

Printing money at the Bureau of Engraving and Printing. The plates are engraved by the finest engravers in the world, and are turned over to the printers. When the money is printed it is sent to the Treasury under guard and deposited in the vaults.

HOME RULE.

It is a common latter-day saying among locally independent voters who still cling to the great parties in national affairs, that state or national politics should not intrude themselves upon municipal or town affairs. This tells how closely the town or city government, the home government, appeals to the tax-payer. And well is it that such is the case. The matter of preserving local order, making laws for the home district, collecting and disbursing taxes, and other

kindred affairs, should be kept strictly within local limits. So important is this self-government and so fully is it recognized on all sides that the state governments give charters to the cities empowering them to act in even wider circles than is usually their wont. Therefore we see it a pretty hard and fast custom that villages, towns, and cities are left to work out their own laws through the medium usually called police power—that is, the preserving of the peace and kindred duties of a government for the immediate welfare of the people.

But there are some functions of the body politic that must be broad enough to protect and govern not only the people of one town, but of all towns within the borders of a state. In the same way it is necessary to work for the welfare of the several townships in the various counties in the state. Therefore we see the state assuming its sovereign right of domain over all the counties within its jurisdiction and at the same time yielding certain powers to the counties as well as to the cities. Thus the city's charter allows it to grant street railway and other franchises, incur indebtedness to build water and gas works, elect its officials and levy a tax for the maintenance of its government. In the same way the county elects officials to preside over the welfare of the townships within its borders, and fix taxes for the maintenance of the jails, hospitals, poor farms, courts, board of commissioners, etc.

STATE SOVEREIGNTY.

Lastly, within the state we observe the sovereignty of the state itself dominating yet by the will of the people all other law within the state. Thus the state taxes for the support of the state government which is for the benefit of all the people within its borders. The state knows no superior. It is supreme, save where, upon signing the constitution of the United States, each state surrendered certain powers to the United States government. It was on the rock of state sovereignty that the ship of state was nearly wrecked on the occasion of the Civil War. Since then it has been an accepted fact that while every state of the Union is independent, a sovereign unto itself, yet it has delegated away voluntarily certain of its powers and these powers only the federal government may exercise. And yet the state protects its people in times of riot with its own militia and resents interference from outside sources. It cares for its unfortunate insane, punishes the criminals in its penitentiaries, enacts measures in its legislature for maintaining peace, order, and promoting education and commerce, etc., among its people. Thus we observe that as benefits from government are to affect greater numbers of widely spread people the governing powers are less concentrated.

Finally we come to the methods which bring about laws for the general welfare of the whole nation. Naturally, in a federation of sovereign states it would be idle for the sovereign states to legislate for the whole. In most of the colonies demands had been made and granted for bills of rights by which the people were assured of certain jealously guarded principles of democracy. No such bill appeared in the constitution. Therefore in quick succession followed a number of amendments in order to satisfy the public mind that the republic was not to become too strongly centralized. Thus the constitution now provides for the safety of the individual

in such precise terms that many a law framed by city or state when tried in the balances of the constitution, has been found wanting and declared void.

CONSTITUTIONAL GUARANTIES.

Under the constitution every man has the privilege of freedom of speech and of opinion through the press. The people may assemble and petition the government to redress wrongs. Every one is entitled to a speedy trial by jury, with immunity from excessive bail or cruel punishment. No person may be held to answer for a capital or otherwise infamous crime unless upon indictment by a grand jury, and no person can be twice put in jeopardy of life or limb for the same offense. The accused has the right to be confronted with the witnesses against him, the right to compel the appearance of witnesses in his favor, and to have counsel for his defense. No slavery or involuntary servitude shall exist except as punishment for crime. All persons born or naturalized in the United States are citizens thereof. No state may abridge the right of vote because of race, color or previous condition of servitude. These immediately foregoing provisions of the constitution do not and cannot secure to the negro, or any person, for that matter, the right to vote, for this is a matter which is still in the domain of, and controlled by, the sovereign states.

Congress must meet at least once every year beginning on the first Monday in December. Each state must respect the acts of other states. The states cannot nullify each other's laws or legal decisions. Congress has the power to admit new states to the Union as they may be desired. A state cannot exercise a function that has been delegated under the constitution to the federal power, nor, in the main, does congress exercise any power not specifically given it under the constitution. However, there is a growing tendency for the central government to strengthen itself, and under the provision of the constitution which permits congress to make all laws necessary to carry out the meaning of the constitution, its powers are constantly growing.

LEGISLATION.

Congress cannot pass a law to punish an offense already committed. State laws in conflict with the constitution are void. Congress cannot lay any disabilities on the children of persons because those persons have been convicted of crimes or other misdemeanors. Each state is entitled to two senators, the smallest having the same rights with the largest. Territorial delegates to congress have the right of debate but not of voting.

QUALIFICATIONS FOR OFFICE.

Congressmen must be 25 years old to be eligible; they serve two years, and may be re-elected. Senators must be 30 years old to be eligible; they serve six years, and may be re-elected. The president must be 35 years old to be eligible; he serves four years and may be re-elected. No president, however, has served more than two terms. The same qualifications are necessary in the vice-president. No naturalized citizen may become president or vice-president, but a male child born of American parents abroad is considered a native-born American, and has all the rights of American citizenship, including eligibility to the presidency. The president has the right to pardon except in cases of impeachment.

The vice-president is, ex officio, president of the senate, but has no vote in that body except to decide a tie.

TREASON.

Treason against the federal government consists only in making war against it, aiding its enemies or adhering to them, and must be proved either by open confession in court or by two witnesses to an overt act. Officers of the government may not accept honors from a foreign court without the consent of congress.

IMPEACHMENT.

The house of representatives has the sole right of impeachment, but the senate conducts the impeachment trial. Persons committing crimes in one state may not have refuge in another. Silver coin is not legal tender in denominations less than one dollar in payments of over five dollars. Copper and nickel are not legal tender. The grand jury is a secret tribunal of 23 men. It hears one side of the case and an indictment by a vote of 12 of these men means that there is good reason for holding a trial. A unanimous vote by petty or trial jury is necessary to convict. Amendments to the constitution require a two-thirds majority vote in each house of congress and must be ratified by three-fourths of the legislatures of the states or by special conventions called for the purpose. When the president calls out the state militia it passes under the control of the federal government, and is under the command of the chief executive.

PATENT LAWS OF THE UNITED STATES

The United States Patent Office issues patents under the seal of the government to any person who has invented any new and useful art, contrivance, manufacture or composition of matter, improvement, or the like, not already patented or known in this country, or not printed or described in any publication, local or foreign, prior to the discovery, and not on sale two years before the application for the patent, unless such sale has been discontinued. Some of the ingenious inventions for which patents are issued include busts, statues, reliefs, designs for printing fabrics, new ornaments, patterns or new shapes of articles for manufacture.

PATENTS AND THEIR CONDITIONS.

The patent is an instrument granting to the patentee, his heirs or assigns, the exclusive right to his invention for a period of 17 years, within the jurisdiction of the United States. Joint patents are issued to two or more people who work on the same invention, and not single patents to each. Patents on foreign inventions for which foreign patents have been already allowed may be secured from this government, unless the article patented abroad has been in use here more than two years prior to the time of application. Patents thus secured, however, expire at the end of the foreign patent-term which has the least unexpired time, if there are several patents, and in no case run over 17 years.

APPLICATIONS FOR PATENTS.

The Commissioner of Patents is the official to whom applications for patents must be directed. With the application

Attorney's room at the Patent Office, where all patent records are kept. This room is always crowded with Patent Attorneys, looking over patent records.

must be filed a written description of the invention, with its manner of making, construction, compounding, or the like, made perfectly clear. In case it is a machine a model must be sent. Drawings also are required for certain inventions. An oath is required of all applicants, stating that they believe the invention new and original and that the applicants are the rightful discoverers.

ASSIGNMENT OF PATENTS.

Assignments of patents may be made, or of an interest in a patent. This is done in writing, and the exclusive right to the patent for the whole or part of the United States may be thus granted. In case of errors, where more than rightful claims have been allowed to a patentee, the patent becomes invalid. But where papers are filed showing such errors, a re-issue will be granted.

CAVEATS.

A caveat is a notice filed with the Patent Office by an inventor stating that he is working on an idea and that he wishes to prevent a patent issuing to any one else who may have the same idea. This costs $10, and protects the caveator from infringement for one year.

PATENT FEES.

All patent fees are paid in advance and run as follows: Filing original application, $15. Designs, for three years and six months, $10; seven years, $15; 14 years, $30; each application for re-issue of patent, $30; filing disclaimer, $10; certified copies of patent, etc., ten cents a hundred words; recording assignments, powers of attorney, etc., three hundred words or under, $1; under a thousand words, $2; over a thousand words, $3.

THE INTER-STATE COMMERCE LAW

Congress is empowered by the constitution to regulate commerce between the several states, and in 1887, under this authority, passed the inter-state commerce law which is in force now and which controls and regulates our internal commerce. This law has for its object the enforcement of equitable dealings on the part of all common carriers with the public, and applies to all such carriers, whether by rail or water, as convey goods or passengers from one state, territory or district of the United States into another. The sovereign power of the states which on this point was delegated to congress, was not surrendered as regards traffic within the state. Consequently the states also have commerce laws which govern traffic within their individual boundaries and have railroad commissions which act in a similar capacity to the inter-state commerce commission.

THE INTER-STATE COMMERCE COMMISSION.

This commission of the federal government is made up of five men empowered by the law to inquire into the methods by which carriers do business, and their rates of traffic charges. The law provides that all rates shall be just and reasonable and that there shall be no discrimination in favor of large shippers. Rates of traffic must be printed so that all shall be uniform under similar circumstances, on the same

road. The books of the companies also must be opened at least once a year for inspection by the commission. Rebates to induce shipment by certain concerns are prohibited. Exceptions to the rules are made for carriage of property for the government, charitable institutions, and during the time of fairs and expositions. Mileage at reduced rates may be issued in certain amounts, as well as excursion and commutation tickets. Reduced rates are allowed for clergymen and passes may be issued for officers of railroads. Passes, as such, however, are prohibited.

DISCRIMINATION IN RATES, REBATES AND POOLING.

And yet with law and commissioners to enforce the law, discrimination in traffic rates is frequent, and pooling, with unlawful rebating and other sharp practices, is common. The Sherman anti-trust act is violated continually. Railway managers have been brought to account repeatedly by the commission for disregarding published tariffs by according lower rates to larger shippers. Grain rates applied to export business have been manipulated to such an extent that for a long time they have been demoralized, and little export grain has moved by rail at tariff rates. The same is true in the matter of dressed meats shipped by the great Chicago packing industries. All sorts of methods are used to control business by the railroads, and in order to grant special and illegal rates to secure big customers, roads have been known to go as far as paying a so-called agent to secure business for them, and the commission supposed to be paid this agent—sometimes amounting to 25 per cent of the freight charges—has been turned over at once by this agent to the shipper—an actual rebate.

LEGAL ACTIONS AGAINST RAILROADS.

While the inter-state commerce commission has been able to discover gross wrongs, such as the merging of competitive roads so as to control traffic, it has been unable to redress many of these wrongs, or to provide against their recurrence, because of the weakness and inadequacy of the law under which they operate. About the only thing that has been done is to ask the Attorney General of the United States to begin numerous actions in equity against railroads for violating the inter-state and anti-trust laws. These actions have fallen into three classes. One is that brought against the railroads in which preliminary injunctions were obtained which required them to apply tariff rates to traffic carried by them, and prohibited them from carrying on any inter-state traffic at any but the lawful published rates. Another case was the action against the great Chicago packers to prevent them from carrying on a beef trust or combination, which stopped all competition. Another was one against the Northern Securities Company and the several railroad companies which have been merged into it.

CIVIL SERVICE REGULATIONS

One hears a great deal about the civil service in these days, and of the laws that are being enacted to regulate it. This service comprises the departments of work under the various municipalities, counties, states and under the federal government. Men and women who work for a public body are said to be in the civil service. It is a well-known fact that politicians in general seek for patronage, or the power of appointing men to office, else they would not strive so hard to be elected, or pay such large sums in aid of certain political parties in campaign times. It can be readily seen that civil affairs in most departments can be conducted much more efficiently if employes who give satisfaction, and who have spent a long time in becoming acquainted with their work, are kept in office regardless of politics, instead of having all public business turned upside down at every election. The effort that has brought about this feeling and put it into practice is called civil service reform, and the laws enacted to carry it out are styled the civil service laws.

The persons employed in the various civic offices of the country number hundreds of thousands. Under the United States government there is the postal service, with its thousands of clerks and carriers, the treasury department, customhouse officials and employes, consular agents, pension clerks and many others. Civil offices in all the states hire great numbers of clerks and laborers, and the counties and cities and towns need policemen, and firemen, and clerks. In President Jackson's time, "to the victors belonged the spoils," and there was a general discharge of employes with every political change of administration. At such a time, the efficiency of the public departments fell to a very low degree. Many times money was paid by subordinates to get their appointments, and much corruption followed. This was true up to a late date in the city of New York, under the control of Tammany Hall.

LEGISLATION TO CORRECT ABUSES.

Abuses went so far in the civil service of the country at large that in 1883 Congress passed laws limiting the appointing and removing power of elected officials. Many departments have since been brought under these laws, and further enactments have been made to hedge about the service. These laws provide for competitive examinations for applicants for positions, and for the promotion of employes through merit rather than influence. But influence still plays a large part. Frequently, trusted officials meet with rebuke for disobeying the law in this respect, and there is opportunity for great improvement along the line of clean service under the merit system.

QUALIFICATION FOR ELIGIBILITY.

Notwithstanding the abuses which work against the law and service the movement for a merit system all over the country has had a salutary effect. The examinations are competitive, the highest on the list receiving the appointment. Persons addicted to the habitual use of intoxicating liquors will not be accepted. Applicants must also be in good health, and must give proof of

good moral character. In many cases recommendations from well known officials are necessary. The examinations are not difficult, save in technical departments, where expert services are required.

The following are some of the subjects on which applicants are examined: penmanship, orthography, arithmetic, interest, discount, the fundamental rules of bookkeeping, the elements of geography, history of the government of the United States, the English language, letter writing, and the proper construction of sentences.

THE ILLINOIS CIVIL SERVICE LAW.

To illustrate the system of civil service, the following extracts from the Illinois civil service law, which governs most of the departments of the civil service of Chicago, are given:

No person shall be admitted to examination for any position in the official service who is not a citizen of the United States, and who has not been an actual resident of the city of Chicago for at least one year next preceding the date of the examination.

Unless otherwise provided in these rules, no person shall be admitted to examination for a position in the official service who is less than twenty years of age at the date of examination, except that applicants for positions of pages and messengers must not be less than 17 years of age at the date of examination.

In special examinations for any place requiring technical, professional or scientific knowledge, or manual skill of a high order, the commission may wave the requirement of residence in the city of Chicago, fixed in Section 1 of this rule.

Application for admission for examination shall be made on blanks in such form and manner, and supported by such certificates of persons acquainted with the applicant, as the commission may prescribe. These blanks will be furnished to applicants for examination.

No question in any examination shall relate to political or religious opinions or affiliations, and no appointment or selection for an office, or employment within the scope of these rules, shall be in any manner affected or influenced by such opinions or affiliations.

EXAMINATIONS.

Examinations shall be held at such times and places as the commission shall designate, and two weeks' notice thereof shall be given, as provided by law.

The subjects for the examination shall be designated from time to time by the commission and shall be such as the needs of the service require, and such as tend to prove the qualifications of the applicant for the office sought, and may include special tests of fitness for any particular place requiring technical, professional or scientific knowledge, or manual skill.

Proficiency in any subject shall be credited in grading the standing of the person examined in proportion to the value of a knowledge of such subject in the branch or part of the service which the applicant seeks to enter, and also the applicant's physical qualifications and health. The relative weight of each subject shall be fixed by the commission for every examination.

The name of no person shall be entered on a register of eligibles whose standing, upon a just grading in the examinations, shall average less than 70 per centum of complete proficiency in the subjects of the examination, taken as a whole, and of such

minimum mark as may be fixed by the commission for any part thereof.

All questions used in any examination shall be first approved by the commission. All examinations shall be conducted under the supervision of, and examination papers shall be marked under the regulation of, the commission. The same series of examination papers shall not be used a second time. No examination papers and no examinations shall be subject to review by the Civil Service Commission, or any of its members, after the posting of the eligible list.

All competitors who attain a general average of 70 per centum or over (and of such minimum mark as may be fixed by the commission for any part thereof) shall be eligible for appointment to the place for which they are examined, and their names shall be enrolled in the order of general average upon the proper registers, which shall be in such form as the commission shall prescribe, and shall be called the "Register of Eligibles."

Names shall remain upon the registers of eligibles for two years from the date of their enrollment unless sooner removed under authority contained in these rules, or by appointment. At the expiration of one year, the eligibles shall, upon a form prescribed by the commission, furnish new certificates of character.

PROMOTIONS AND REMOVALS.

All promotions in the classified service, unless herein otherwise provided, shall be from grade to grade, and shall be made upon voluntary, open, competitive examination. Competition in such examinations shall be limited to the employes in the next lower grade of the same position, serving in the department in which the position exists, unless the Commission shall deem it for the interest of the service to admit competitive employes in other grades or other divisions, serving in that or other departments.

No officer or employe in the classified service who shall have been appointed under these rules, and after examination, shall be removed or discharged except for cause, upon written charges and after an opportunity to be heard in his own defense. When a removal is deemed necessary, the appointing officer shall immediately notify the Commission in writing of the grounds therefor. Such grounds shall be investigated by the Commission, and the accused person shall be given an opportunity to be heard in his own defense, provided, however, that such officer or employe shall file a written request for investigation within three days after the date of his removal. The finding and decision of the Commission shall be certified to the appointing officer and shall be forthwith enforced by said officer. Pending such investigation, the appointing officer may suspend the accused for a reasonable period, not exceeding 30 days. Nothing in this section shall be construed to require such charges or investigation in cases of laborers or persons who have the custody of public money, for the safe keeping of which another person has given bonds.

THE UNITED STATES POSTAL SERVICE

NUMBER OF POST-OFFICES AND EMPLOYES.

One may gain some idea of the enormous work undertaken by the United States Post-Office department when it is known that it directs the operation of 74,000 post-offices and over 200,000 employes.

RECEIPTS, EXPENSES AND AMOUNT OF MAIL.

The cost of running the department for one year is nearly $110,000,000, and the receipts are about as much—for, in spite of the excellent organization of the department, the government is so liberal in the matter of second-class postage that expenses are not always met by receipts. To indicate the enormous extent of this business, it may be said that, every minute of the day, about 12,000 messages are delivered. The service is constantly growing and these figures will soon be eclipsed. The department handles about 7,000,000,000 pieces of mail annually, of which about one third are letters.

This growth is in marked contrast with the meager showing of the department under Timothy Pickering, the first postmaster general. In his regime the work of a quarter of a year was represented by $63,000 in receipts and expenditures—an amount now excelled every five hours of the day. Little could one foresee in this simple beginning the smoothly-working system of to-day, with its lightning mail trains, its free rural and city deliveries, its special deliveries that rival the telegraph, and its gigantic money-order department.

Cancelling postage stamps in the post office. This machine is a late invention, and is operated by electricity. It cancels from three to five thousand letters a minute.

POSTMASTER GENERAL'S OFFICE.

This great branch of the government business machinery is divided into four sub-departments, each under the supervision of an assistant postmaster general. These are: first, the branch that has charge of the administration of the post-offices, carriers and clerical force and the actual management of the general work of the offices. This department expends annually about $40,000,000; second, the branch for the transportation of the mails, which contracts with the railway companies for service, etc., and costs about $35,000,000 a year to operate; third, the

branch which keeps the financial accounts and furnishes stamps, postal cards, etc.; fourth, the branch which appoints over 70,000 postmasters and directs the force of inspectors. In addition, there is an auditing bureau under the Treasury Department, employing over 500 clerks, which scrutinizes and audits all post-office accounts.

SALARIES OF POSTMASTERS.

The expenses and receipts of the numerous post-offices differ greatly, the New York receipts being tens of millions of dollars, with a great percentage of profit, while many of the small country offices do not sell $25 worth of stamps a year. The salaries of postmasters vary with their positions. Those who are appointed by the President, about 4,000 in number, receive not less than $1,000 yearly, while the fourth-class offices, in which salaries are less than $1,000, number over 70,000 and are filled by appointment of the postmaster general.

CITY MAIL DELIVERY.

Several departments of the service deserve particular mention. The free city delivery system is one of these, employing over 140,000 carriers, at an annual expense of more than $14,000,000. This accomplishes the delivery of mail to the door of every resident of the larger cities, without the least inconvenience. The marine postal service on the great lakes involves the delivery of mail sent to and from sailors on moving vessels. The smoothness of the operation of this branch of the service can be best noticed at the mouth of the Detroit river, where during eight months of the year vessels pass every three and a half minutes of the day and night. This great fleet has a perfect mail service. All vessels are met and mail is collected and delivered, with the vessels in full motion. Water-tight bags are used for this purpose, as a safeguard in case the collector should have a "spill." The letters are stamped on the back with the name of the vessel to which they are destined.

RURAL DELIVERY SERVICE.

There is nothing perhaps so remarkable in the history of the post-office department as the free rural delivery service, but recently inaugurated. By means of this delivery, farmers throughout many sections of the country receive their mail regularly, at stated intervals, without the necessity of calling for it at the postoffice, possibly many miles away. The rural delivery routes are rapidly increasing, and so popular are they that, in many cases, to secure them, the farmers have paid for the grading necessitated by the establishment of routes. Among the advantages derived from this service are larger postal receipts and a greater use of newspapers and magazines, which keeps the people better informed, and increases the value of land because of the better means of communication. Farmers also are able to keep in closer touch with market quotations, through the papers, thus enabling them to get the best prices for their produce.

RAILWAY MAIL SERVICE.

Most important of all branches of the service is the railway postoffice, which started in 1864, now employs about 10,000 men, and annually covers nearly 300,000,000 miles on about 174,000 miles of track. The mail handled by this branch of the service has of late doubled nearly every

six years. In 1884, the mail distributed in railway postoffices amounted to 4,519,-661,900; in 1898, 12,225,706,220; and at present, about 15,000,000,000 pieces are handled. So efficient is this service that mails are carried, sorted, pouched and delivered to every point desired, without delay at the distributing point. The work is so exacting that clerks must be well versed in its requirements. Every office in a territory must be known to every clerk, and no forgetfulness or error in placing in the mail bag is permitted.

Extremely stringent examinations are held for applicants for positions in the railway mail service, and so well has the clerk learned his lesson, that on an average, only one error is made in the sorting and delivery of 10,428 pieces of mail.

THE FAST MAIL.

Time is such a factor in the railway mail service that new trains are being constantly scheduled by the railway companies, and all sorts of devices are used to secure the rapid transit of mails. Now, the fast mail train crosses the continent four hours ahead of any passenger trains, and often between Chicago and Omaha, a speed of from 80 to 90 miles an hour is attained. In this rapid race many smaller stations must necessarily be swiftly passed. The mail received by the railway mail cars at such points is taken on by an automatic device like a crooked arm, projecting from the open door of the cars, which, by pressure of a lever, will reach out, seize a bag of mail fastened to a post on the railway platform, and hurl it inside the car. Mail for these stations is dropped off generally by hand.

The railway branch of the postal service is dangerous, as many as 75 employes having been killed and over 1,000 injured, in a single year. In this branch of the service, in order to save time in the final delivery of mail at its destination in the large cities, men well informed as to these cities are on board the fast trains, who sort the mail into the pouches so well, that the latter may be taken directly from the train to the numerous sub-stations in the cities.

MAIL BAGS.

It may well be imagined that a great many bags are necessary in the mail service. The great trend of bags is from the East westward, and from great business centers toward the country districts. Every year, nearly a million and a half bags are repaired and put into service, most of them through the New York postoffice. Naturally, some postoffices will accumulate more bags than they can use for return mails. Cincinnati and St. Louis are made distributing points from which a call for from 5,000 to 20,000 bags may be supplied at almost any time.

Bags are supplied by contract. All sorts of them are in use, and of course the greatest demand is for new ones. The greatest flow of bags, after they get into service, is from the offices at Washington, Baltimore, New York, Chicago, Boston and Philadelphia. The period of greatest activity is during the Christmas and New Year holidays, when business firms and individuals are sending out great quantities of packages by mail. The bags containing these gradually return to the central stations late in January, and once more flow out in May, when the spring advertising season sets in. Of the numerous kinds of bags, there must be those for the mountain carriers, the runner on snowshoes, knapsacks,

and bags for the Alaskan dog teams, and saddle bags for the pony express. One of the recent odd bags devised is a perforated affair, for transporting live queen bees to the islands of the Pacific.

Model representing Porto Rican Mail Carrier in the Post Office Department. Model for exhibition at the Louisiana Exposition at St. Louis.

FORWARDING MAIL IN ALASKA.

It is interesting to know how the postoffice department delivers mail in the far-off, frozen fields of Alaska. Kotzebue is the farthest northern point at which deliveries are made, and this necessitates an overland journey of about a thousand miles. A train of six heavily coated Alaskan dogs draws the mail, the deerskin sleeping sacks of the mail carriers, who travel in couples, and the food, snowshoes, shotguns, cooking utensils, stove, etc. All this is loaded on a light sled, and, all told, weighs about 360 pounds. Frequently, raw winter winds must be encountered and stops must be made to thaw out frozen feet, fingers or ears. Stops are also made at wayside native huts, to secure extra food in case the supply runs out. Sometimes it is necessary to bunk out on the snow. All sorts of difficulties are to be expected. The dogs are likely to fight; great snowdrifts frequently block the way, and sometimes directions are lost. Arctic fogs are encountered, and the mercury sometimes drops to 50 or 60 degrees below zero.

Alaskan Mail Carrier and dogs at the Post Office Department, for exhibition at the St. Louis Exposition.

When it is necessary to camp in the open, drink that is boiling hot when removed from the fire, is cold before it is used, and the fork often freezes to one's lips. Biscuits and doughnuts are often so hard that, actually, they have to be cut with an axe. The carriers meet many poor natives on the way. Sometimes, the supply of fish has failed, and natives who have been snowed in are compelled to cut up their skin boats for food.

Opening dead letter packages in the Dead Letter Office of the Post Office Department. All kinds of curious merchandise and periodicals, and even infernal machines, are received here and opened. When a large amount of merchandise is collected, it is placed in blind packages and sold at auction.

MONEY ORDERS.

The money-order division of the post-office department is one of the greatest clearing houses in the world, and easily rivals the foremost banks. This is one of the greatest sources of convenience to the public. The system is so complete that money may be sent by it almost to any point in the world. By means of the international money-order system, money is exchanged between different countries. So great is the business of this division, that money orders numbering over 30,000,000 are issued in a year for amounts aggregating about $210,000,000. This work necessitates the employment of 350 people who do nothing but add up columns of figures all day.

THE DEAD-LETTER OFFICE.

Many misdirected letters and packages cannot reach their destination. Often very odd methods are used to direct mail, pictures sometimes being used instead of writing. The postoffice department usually solves such riddles and delivers the mail to its proper destination. But about 20,000 letters, unclaimed, unaddressed or misdirected, are sent to the dead-letter office yearly. Packages, even, reach great figures, often as many as 50,000 being sorted in the office. It saves millions of dollars for those interested by eventually remitting money and valuables to the sender, in cases where the person for whom they were intended cannot be found. This office often finds snakes, dynamite and other freakish things in unclaimed mail.

MAIL PACKAGES.

Package carrying has grown to a great volume. Even the express companies are meeting serious competition at the hands of the postoffice department. In the western hemisphere, at present, nearly a score of countries and colonies can be reached by package post, which will carry merchandise, etc., to the weight of 11 pounds.

OCEAN POST-OFFICES.

There were no uniform rates for foreign mails until 1874. Such rates as did exist were regulated largely by treaties with the separate countries. To-day, however, five cents will carry a letter the world round, until it finds its owner. Sea "liners" have postoffices aboard similar to those on fast trains. Thus mail may be sorted en route, and given direct to local carriers in foreign countries, without having to go through land offices. Many tons of mails are carried between trains and the mail steamers in the harbor of New York, by the transfer boat, "Postmaster General."

BUREAU OF ENGRAVING AND PRINTING WHERE U. S. GREENBACKS ARE MADE.

UNDESIRABLE IMMIGRANTS AND STATISTICS OF IMMIGRATION

Once upon a time a lady set up housekeeping in a very large mansion. Indeed there was so much unoccupied space in it, that she was quite pleased when a number of people came to live with her and she treated them so hospitably, that they sent back good reports to the various corners of the earth from which they had come, and others were encouraged to move in also.

The family grew and grew, and the new members who were being constantly added, took kindly to the laws and customs of their adopted mother, and in a little while after they came, it was always quite difficult to distinguish the new from the old. Nearly all who came were hard-working, earnest men and women who did everything in their power to promote the welfare and happiness of the great family.

THE PENALTY OF UNWISE HOSPITALITY.

At last a time came, however, when the lady with the big house, whose rooms were rapidly filling, began to wonder if she had not been a little too free in her hospitality, for she found it was being abused. People were coming in great numbers who did little or no work and who were very active in vice and crime. They would not take the trouble to learn the language spoken in their new home, and they would not mingle with the other residents, but kept by them-

MAP OF EUROPE,

North of Line Emigration to America has decreased in the last 10 years. South of Line Emigration has increased. Black portion shows where the worst Italian element comes from.

selves and continued the evil, shiftless ways that had made them undesirable members of the communities they had left.

1,000 VICIOUS IMMIGRANTS DAILY.

This allegory fitly applies to much of the immigration that is pressing down very hard on certain parts of the country. From Italy and Sicily are coming to us in great hordes, lawless, ignorant men and women, who have been taught just enough in their native land to enable them to pass the immigrant inspection at Ellis Island. One million lira ($200,000) is spent annually on the education of the Neapolitans and Sicilians who intend to emigrate to the United States, in order to prevent their rejection by the American authorities. Of the 1,400 immigrants on the steamship Belgravia, which arrived here in December, 1902, 256 individuals whose names appeared on the ship's manifest, it was found upon a test investigation, had given fictitious addresses of alleged relatives and friends in this city who would be responsible for them. They resort to any means, dishonest or not, to slip into the country, and they are coming in at the rate of nearly 1,000 a day.

NOT PROUD OF THESE COUNTRYMEN.

The better class of Italians and Sicilians say they themselves would be glad to have their worthless countrymen excluded from the United States, because they bring their mother country into disrepute in the land of their adoption, by all sorts of crime and dishonesty.

GREATEST IMMIGRATION ON RECORD.

Germany, England, Ireland, Russia, Norway, Sweden and Denmark continue to send us great armies of men, women and children, but the great majority of the people from these countries are desirable, and are as welcome now as were their forefathers when they came long ago to help build the nation when the gracious lady of the Western Hemisphere first threw open her doors to the world.

In the fiscal year ending July 1, 1903, 195,439 more immigrants came to our shores from Europe than during the preceding twelve months.

From the New York Herald.
A SICILIAN IN NATIVE COSTUME.

More than one-fourth of this entire European increase of emigration occurred within the narrow boundaries of Italy, including Sicily and Sardinia.

OVER-SUPPLY IN THE GREAT CITIES. UNDER-SUPPLY ON THE FARMS.

Meanwhile, as ignorant outcasts from the mother country continue to crowd into our already congested cities, a cry keeps

coming from the wheat-growing West for men to harvest the crops.

Every year, in the fall, thousands of able-bodied immigrants are to be found suffering in over-packed tenements—choking the labor-markets of great cities; while farmers, short of hands, are facing the loss of at least part of their crops because they cannot get labor.

We are indebted to the Little Chronicle, of Chicago, for the above article.

STATISTICS OF IMMIGRATION.

It is interesting to note the periods of fluctuation that mark the extent of immigration into the United States. There was a steady increase from the close of the Civil War until the panic of 1873. Then a decrease took place, with no reaction until 1880. In 1882, the number of immigrants was 788,992, which is the maximum number from 1867 up to 1902. The following table of figures shows the total number of immigrants arriving on our shores from 1867 until June 30, 1903:

1867	298,967	1886	334,203
1868	282,189	1887	490,109
1869	352,569	1888	546,889
1870	387,203	1889	444,427
1871	321,350	1890	455,302
1872	404,806	1891	360,319
1873	459,803	1892	623,084
1874	313,339	1893	502,917
1875	227,498	1894	285,631
1876	169,986	1895	258,536
1877	141,857	1896	343,267
1878	138,469	1897	230,832
1879	177,826	1898	229,299
1880	457,257	1899	311,715
1881	669,431	1900	448,572
1882	788,992	1901	487,918
1883	603,322	1902	496,534
1884	518,592	1903	857,046
1885	395,346		

RECLAIMING OF ARID AMERICA

IRRIGATION IMMIGRANTS.

In the far southwestern portion of the United States, in the section drained by the Colorado river, the Nile of the western continent, is progressing the great work of reclaiming the great southwest.

ALKALI PLAINS OF COLORADO.

Any one who has gone over this country knows too well the stifling heat of these alkali plains. Probably no more desolate place exists than the Colorado Desert on the borders of California and Mexico. And yet such is man's persistence and ingenuity that these arid stretches of waste will soon bloom like oases.

Irrigation has come to the rescue. The land in itself was fertile enough, and, in fact, the potentialities of the soil for everything known in agriculture are to-day wonderful. Further, the climate is such that with water, production will be boun-

tiful. And work is going fast apace. Ere long lands that were strewn with the bleaching bones of unfortunate pioneers who were lost in this trackless country, will manifest their richness. Here are mountains of iron, coal and salt,—mines unworked, whose ore would be worth a hundred dollars a ton at the smelter. Soon this is to be productive under the hand of advancing commercialism.

ARTIFICIAL CANAL AND OLD RIVER BEDS.

The railways have set the pace. With the knowledge that Los Angeles, which, although in blossom itself, is but a short distance from the desert, would profit ere long from the development of this country, railway magnates began pushing southwestward from Salt Lake City. Already the faith in the country has begun to reap rewards. But a short time ago, this natural bride of the Colorado river, this truly rich though seemingly valueless waste, was given the advantages of meager irrigation. The method was simple. Water was taken from the river near the Mexican border by means of a large artificial canal, and conducted through old river beds to the land to be watered. The old river beds needed very little done to them save cleaning of old brush in order to make them the channels of the system. For some 50 miles these river beds are used, and from them extends a system of lateral branches.

The land formerly was almost bare of vegetation, save that here and there were heavy growths of mesquite. But everywhere this delta of sedimentary deposit had a soil deep and rich. Now, instead of the somber scenes of useless desolation are springing up vistas of green fields, bubbling creeks and pleasant homes. Wherever the water touches the soil the growth is phenomenal. The climate is similar to that of Southern California and the greater part of the year is delightful. Vegetation springs to maturity almost in a single bound. Green

By courtesy of the Atchison, Topeka & Santa Fe R. R. Company.

BOTTOMLESS LAKE—ROSWELL, NEW MEXICO.

How Artesian wells near Roswell may be made a great power for good.

corn is ready to eat in a double fortnight after planting. The date palm matures in five years. However, it is grain, alfalfa and live stock that will flourish most abundantly in this new paradise. Even Mexico will profit by the irrigation. Mexican lands have been purchased, water is taken to them by construction companies, and the canal system grows apace.

TAPPING THE COLORADO RIVER.

The water supply itself when rightly led is everlasting. The Colorado river at its

lowest stages carries enough water to irrigate 8,000,000 acres, and of these there are about 3,000,000 acres that can be thus improved simply by the force of gravity. One great engineering feat in connection with this wonderful land reclamation was that of tapping the Colorado. It was necessary to tap this stream so that there would be no danger of flooding the surrounding territory during high water season. This was done by selecting a spot where there was a natural heading in a hill of rock opposite the most powerful current in the river. Strong works of timber and stone were built here taking in the water at a depth of 9 feet below low level. This heading has already withstood heavy pressure successfully.

CONGRESS PROMOTES IRRIGATION.

After nine months of careful investigation the Geographical Survey Department of the United States decided upon five irrigation projects which are being developed under the terms of the arid-land reservation act of June, 1902.

One of these projects is the Gunnison tunnel scheme which is expected to reclaim nearly 100,000 acres near Montrose, in Central Colorado. In Nevada it is also proposed to divert water from Lake Tahoe, California, and its outlet, the Truckee river, into the Humboldt Valley, and supply settlers in the vicinity of Reno. Two hundred thousand acres may be reclaimed here. Then there are 500,000 acres along Milk River, in Montana, and 200,000 acres at Tonto Creek, which will be reclaimed.

In New Mexico artesian wells are being bored for use as means of irrigation, and great tracts of barren wilderness are being redeemed to the service of agriculture.

"UNCLE SAM" AND NUT CULTURE

The Department of Agriculture at Washington is pursuing the plan of distributing, on special recommendation of congressmen for each donation, choice and desirable varieties of seedlings, which people shall find it worth their while to plant.

Extensive plantations of budded and grafted seedlings have been set out on the government's experiment farm at Arlington, across the Potomac, and from this source the supply of trees required for distribution is drawn. Large quantities of tree seeds, such as those of the Kentucky coffee trees, and the "burr oak," which bears the largest acorns produced by any species of oak native to North America, are shipped free to applicants. In this way many bushels of paper-shelled pecan nuts, four times the ordinary size, and obtained from a few freak trees that are scattered through the "pecan belt," have already been sent out for planting.

THE PECAN AND PERSIAN WALNUT.

Uncle Sam aims especially to encourage the cultivation of improved varieties of nut trees, such as the pecan, the Persian walnut, certain other kinds of valuable walnuts from Japan, and the hazel nut. Of the last named, otherwise known as the filbert, the government has secured a new species from Washington state, that grows on a tree sixty feet long, which, because the stem is too slender to hold itself

upright, runs along the ground like a vine. The "vine" bears pods, in each of which are found two filberts, in place of the usual single one.

THE JORDAN ALMOND.

It has also procured "bud wood" of the veritable Jordan almond for the first time from Spain. Many millions of pounds of Jordan almonds are now imported into the United States annually.

The Department of Agriculture employs the services of half a dozen "agricultural explorers," whose business it is to ransack every corner of the world for whatever seems desirable in the way of new or valuable plants. The same man who secured the Jordan almond, notwithstanding the obstacles thrown in his way by Spanish growers, sent over not long ago "bud wood" of some wonderful Persian walnuts, which are six times the size of ordinary ones, and deliciously flavored. The wood has been used for grafts on common walnut seedlings, and already some thousands of the grafted trees are on hand.

THE ENGLISH WALNUT.

The growing of Persian (otherwise known as "English") walnuts has become an important industry in Southern California during the last few years, the annual crop amounting to more than 2,000,000 pounds.

There are other and valuable kinds of walnuts which the Department of Agriculture is propagating with the help of buds and grafts, and one of these is the so-called "Japanese walnut," somewhat smaller than the Persian, with a pointed shell and a deliciously flavored, though more oily, kernel. There is also the "Siebold" walnut, from Japan, of which a large number of grafted seedlings have been raised. Its nuts are not large, but are of excellent quality, and the husks containing them are borne in clusters somewhat like grapes.

PROFIT IN PECANS.

A grove of pecan trees will easily give in ten years an annual profit of $1,000 an acre. A full-grown pecan tree of the ordinary kind produces two barrels of nuts each season, worth $15 a barrel, wholesale.

The cultivated chestnut is being grown in superior varieties. Improved by grafting, the nuts bid fair to be of giant size and exquisite flavor.

THE COCOANUT PALM.

The Department of Agriculture is doing its best to encourage the cultivation of the cocoanut palm in Florida, where large plantations are already in bearing. The kernels of 500 cocoanuts yield one hundredweight of oil, and it takes about 240 of the nuts to produce a hundredweight of copra, which is the dried kernel. The kernels of three average cocoanuts give one pound of the dried "meat." About 40,000,000 cocoanuts are used for confectionery annually.

SELLING NUTS AT MARKET.

WHAT THE WEATHER MAN DOES

THE WEATHER BUREAU. SIGNAL STATION AT MOUNT WASHINGTON, NEW HAMPSHIRE.

Everybody knows the weather man. Nearly every community formerly depended upon some local prophet to foretell the weather. Predictions and traditions of all sorts were heeded, but little study was given to the weather from a scientific point of view. Even to-day the weather man is made the butt of the jokes of the fireside.

As a matter of fact, the weather bureau of the United States Department of Agriculture instead of being a joke, testifies to its efficiency by issuing more than ten thousand weather bulletins daily, not including the forecasts printed in the newspapers. While weather prognostication frequently goes awry, the science (for science it is) of meteorology not only deserves commendation in its present stage of development, but has shown itself acceptable even by the most skeptical.

A SCIENCE OF TENDENCIES.

This science is one of the tendencies. Where other sciences are based on actual and existing facts, the work of the weather bureau has to do with the probable developments of atmospheric phenomena. The weather man, equipped with rain gauges, weather vanes, gauges for calculating the speed of wind, and an intricate system of communication with other weather men throughout the country, makes it his business to register conditions of the weather and to deduce from them the kind of weather likely to prevail at a certain time in any given locality.

STORM CONDITIONS.

A storm may be brewing around Medicine Hat. The direction of the wind, the lowness of the barometer and other conditions may indicate clearly that the storm will slide down in a southeasterly direction and strike Chicago. Immediately the weather man from his eyrie, in the Auditorium tower, in Chicago, for instance, sends out messages over the whole Central West warning mariners on the great lakes, as well as farmers who have perishable crops, that a storm is approaching. From an apparently unknown cause, a "low" barometer is noted in Kansas. The storm suddenly veers in that direction, and the Chicago weather man once more is the subject of many jests.

Such conditions constantly arise and it is only by the most careful observation that

all of them are noted, and proper deductions made therefrom. As a matter of fact, however, so efficient has become this country-wide service, that some weather prognosticators have to their credit as many as nine out of ten correct predictions.

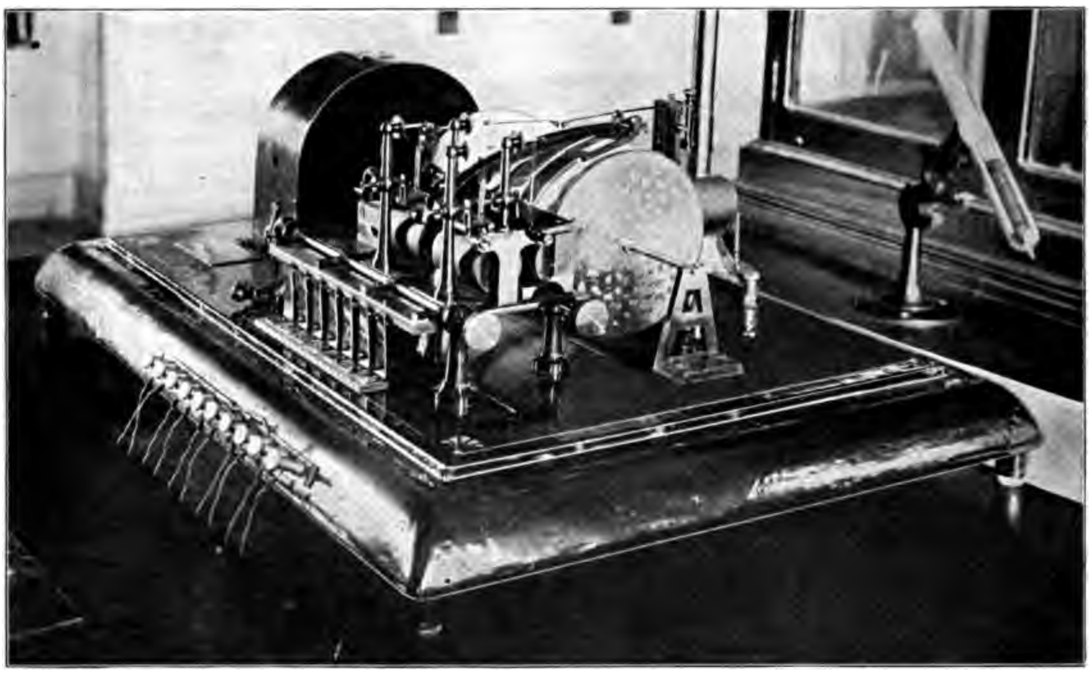
AREA COVERED BY THE SIGNAL SERVICE.

The area embraced in the weather-bureau service extends from the Atlantic to the Pacific, from the north coast of South America northward to the extreme northern Canadian habitations. Records are carefully made of cold waves, hot waves and storms. Bulletins are sent on postal cards printed by postmasters, from telegraphic reports, to outlying towns, for display in suitable places.

MILLIONS OF DOLLARS IN PROPERTY SAVED YEARLY.

So complete is this service that every year millions of dollars' worth of property are effectually protected from damaging storms by timely signals.

At nearly every port there is either a complete weather observatory, or a storm-signal station where a system of danger lights is displayed at night or flags by day, warning the navigator of approaching storms. The shipping of the Atlantic seaboard is thus protected with greater certainty than that on any other American coast. One reason for this is that, except those from the Gulf, nearly all the storms which sweep the Atlantic coast, originate in the Mississippi Valley, and the service of the weather bureau shows that they reach



Instrument at Weather Bureau, which records the direction and velocity of the wind, the sunlight, and the rainfall on the same sheet of paper. A late invention.

Prof. Garrett and his clerks preparing the weather maps which are sent out to all cities each day. These maps show the weather forecast for all the United States.

the Atlantic coast in about 24 hours. Hence a warning of the beginning of one of these valley storms, gives sufficient notice to beware.

THE GALVESTON HURRICANE AND TIDAL WAVE.

Among the great storms which have been accurately forecasted is that which resulted in the tidal wave and hurricane that swept over Galveston, Texas, in 1900. This was detected in the ocean south of Porto Rico, on September 1 of that year. So timely was the warning that little or no loss of property occurred to the shipping interests of the open waters of the Gulf. The destruction at Galveston was less than it would have been had no warning been received.

WARNING OF COLD WAVE PREVENTS $3,500,000 LOSS.

There is an instance on record where more than three and a half million dollars worth of property was saved by a warning of the advance of a single cold wave. The fruit interests of California profit much by these warnings.

THE CRANBERRY CROP DEPENDENT ON FROST WARNINGS.

Flood-gates in the cranberry marshes of Wisconsin are regulated by the frost warnings of the weather bureau. Sugar growers of Louisiana, orange growers of Florida, and truck gardeners in many quarters receive timely warnings of frosts and protect their growing products.

GREAT FLOODS OF 1897.

It is frequently possible to foretell several days in advance the possible flooding of a river. High water is noted far up the stream, and residents in the low lands have time to save their chattels. During the great floods of 1897 so complete were the warning bulletins which predicted the submergence of great districts that, it is estimated, $15,000,000 worth of live stock and removable property were saved.

THE THERMOMETER AND BAROMETER.

A word about the instruments in use by the weather bureau is here appropriate. Naturally the thermometer is of prime importance as it registers the degrees of heat and cold. The barometer indicates the pressure of the atmosphere and its changes and generally shows the origin of a storm or its direction.

THE BAROGRAPH AND ANEMOMETER.

The barograph is an automatic barometer which keeps perpetual record of changes in atmospheric pressure. The anemometer registers the speed of the wind; it is a small windmill connected with a dial.

THE TELETHERMOMETER AND HYGROMETER.

The telethermometer is a combination of telegraph and thermometer, registering automatically, inside of the signal office, the outside temperature as communicated by wire from the thermometer without. The hygrometer notes the humidity of the atmosphere and aids in forecasting rains.

THE ANEMOSCOPE.

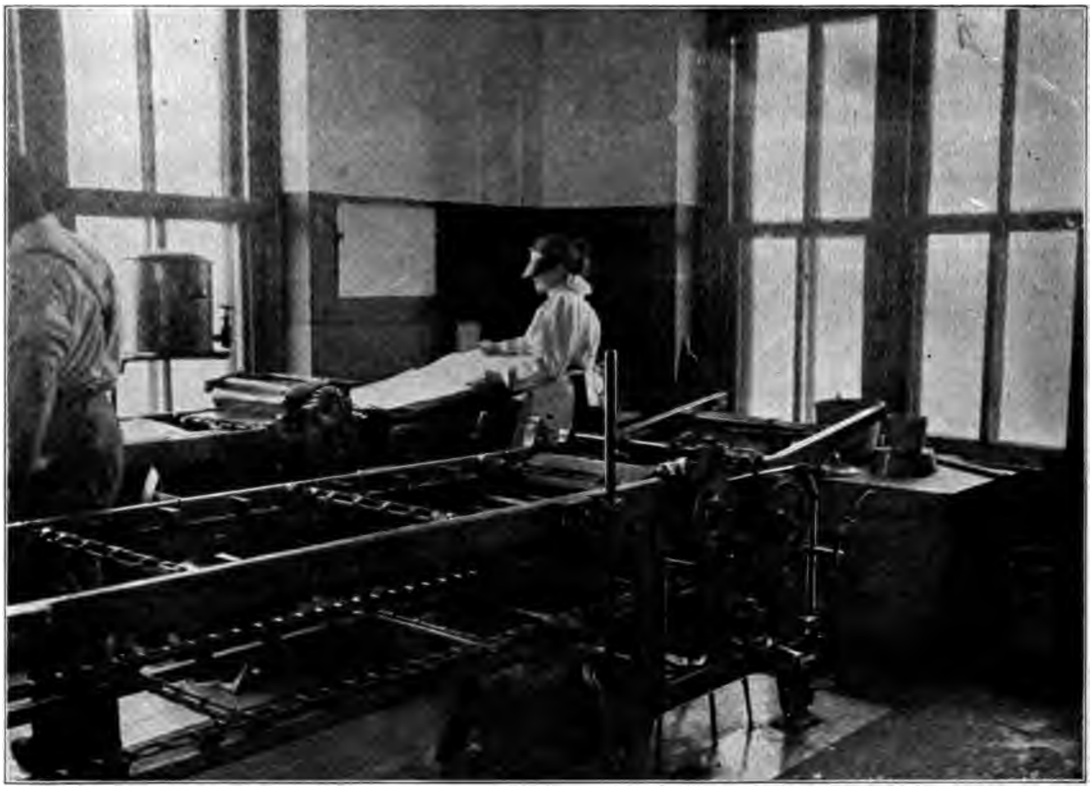
The anemoscope, or weather vane, points in the direction of the wind. There is also a triple register, which notes the conditions of rain, wind and sunshine.

This country is in the lead in the matter of practical weather bureaus, which is largely due to the great extent of our territory. The government expends about $1,000,000 annually upon this service.

POSTAGE-STAMP DEPARTMENT

20,800,000 PRINTED DAILY.

The bureau of engraving and printing at Washington, D. C., strikes off about 20,800,000 stamps every day, and the daily shipments of stamps to the 70,000 or more postoffices throughout the United States run from 10,000,000 to 70,000,000. About ing the little certificate that appears on the letters in the United States mails is a tremendous one. While billions of stamps are printed in a year, every detail of the big job is done by a force of about 200 men and women.



Gumming postage stamps in the Bureau of Engraving and Printing. About two hundred thousand stamps are gummed each day.

100,000,000 stamps are always kept on hand ready for any emergency.

The order sheet for stamps is an accurate barometer of industrial conditions in the United States, and the sale of stamps has jumped with leaps and bounds since 1900. The task of printing and distribut-

BUT ONE SHEET, OF 400, LOST IN THREE YEARS.

In the last three years only one sheet of stamp paper has been lost. Four hundred stamps are printed on a sheet, which goes through the hands of a couple of hundred employes.

The process of turning out a postage stamp is similar to that of printing a bank note.

THE GUMMING PROCESS.

The method of applying the gum to the stamp sheets is entirely mechanical except in the counting. The sheets are fed into a hopper, where they pass between rollers, the lower set of which revolves in a vat of melted gum. This vat is directly over a heater which is regulated automatically with scientific accuracy. Over these gum rollers the stamps pass on a continuous chain, which carries them through wooden compartments heated by hot water pipes. When the sheets emerge the gum is dry, and they are ready for the counter. The basic principle of the gum, which the government manufactures, is cassava starch.

The government has been printing its own postage stamps since 1894. Previous to that year the work was done under contract.

STAMPS USED IN THE PHILIPPINES, HAWAII AND PORTO RICO.

The insular possessions are beginning to draw upon the government for large shipments of stamps. The Philippines take about 6,000,000 a year and Hawaii and Porto Rico each about 3,500,000 a year.

LEGISLATION TOUCHING POSTAGE.

For all practical purposes the history of postage stamps begins in the united kingdom, and with the great reform of its postal system in 1839-40. The use of adhesive stamps in the United States was authorized by an act of congress approved March 3, 1847, and on June 1, 1856, prepayment by stamps was made compulsory. Until 1863 the rates of postage were based upon the distances over which the mails were conveyed. In 1846 these rates were: Not exceeding 300 miles, 3 cents; exceeding 300 miles, 10 cents. In 1851 the rates were reduced to 3 cents for distances not exceeding 3,000 miles, and 10 cents for distances exceeding 3,000 miles. In 1863 a uniform rate of postage without regard to distance was fixed at 3 cents, and on Oct. 1, 1883, excepting, however, lottery matter, coins, jewelry, merchandise, etc., the rate was reduced to 2 cents.

The portraits of but two women have graced the stamps of Uncle Sam. The cheerful countenance of Martha Washington appears on one of the last series, and that of Queen Isabella of Spain on an issue authorized at the time of the Chicago World's Fair.

MACERATING OLD MONEY.

HOW THE PRESIDENT OF THE UNITED STATES OFFICIALLY TRAVELS OVER THE COUNTRY

Great and elaborate preparations attend the occasional departure from the capital of the President of the United States. Years ago, the chief executive could leave Washington without attracting much attention. Now it is altogether different. The average person who follows the course of the President in his tours from place to place probably never entertains a thought of the planning necessary on the part of the presidential secretaries and railroad officials, to bring about the arrival and departure of the President on time, and to insure the highest degree of comfort for himself and his companions.

THE PRESIDENT AT HOME.

In these days of improved railroad operations and precise manipulation of lines, delays are not looked for on important routes, and accidents have come to be exceptional. Consequently, most people may not perceive anything unusual in the progress of the President's train. But, although the ordinary express or accommodation train may maintain the schedule without unusual demands upon the railroad officials, this is not true of a presidential train.

EXTREME PRECAUTIONS.

In this case, extreme precautions are taken in order that there may be the least

possible danger of delay or accident. Of the extraordinary regulations necessary to insure the dispatch and safety of such a train no one but the interested railroad officials, themselves, can have any adequate knowledge or appreciation.

THE PRESIDENT'S PRIVATE SECRETARY.

The general supervisor of the whole trip and its details is, of course, the President's private secretary. When a trip is decided upon and the places to be visited are designated, the next thing is to fix the duration of the journey, and the secretary, in a general way, maps out the itinerary. A rough draft is submitted to the President for his approval, and when it is obtained, the secretary assigns the details to particular men, all specialists, and even experts, in their particular lines.

INSTRUCTIONS TO RAILROAD MEN.

The first to be consulted are the railroad men. Then the departure of the train is preceded several days by elaborate instructions to all the officials and trainmen who are to be in any way responsible for the care of the train. These instructions are very detailed, and reach even the humblest employes. They require that section men should be stationed at all crossings where there are no regular flagmen, and that a man should be stationed at all switches to guard them from being tampered with before the train passes. Roadmasters are instructed to go over their divisions in person before the President comes, and to observe and inspect everything.

All the men concerned are ordered to be on hand at least 30 minutes before the presidential train is due to pass a given point, to insure the absolute safety of the people's executive. Engineers are instructed to use extra precautions in going by stations, to guard against loss of life and any attendant delay, and also to keep the train well under control, so as to be able to make a quick stop in case of any sudden happening or apparent danger.

THE RIGHT OF WAY.

In instances where the special schedule of the President's train interferes with the running of the regular trains, the regular service is retired for the time being, and the special train is given the right of way. The regular freight service also receives special attention, and is never allowed to interfere with the schedule of the presidential train. In fact, freight trains are usually kept out of the way, and are not permitted to be upon any main track over which the President's train is to pass. In addition to keen watchfulness along the line, the movement of the train is also safely guarded against any sudden breakdown in its own mechanical parts, by the continual presence of an expert carman, who knows a car thoroughly, and is able to do any repairing that may be necessary.

THE TELEGRAPH OPERATOR AND LINEMAN.

An expert telegraph operator and lineman are also a part of the crew, so that in case of need the lineman can climb a pole and tap a wire, and then the operator would be in a position to communicate with any station along the route. In this way, messages of importance can be sent ahead of the train, and in case of a serious breakdown, assistance can be summoned from a distance.

PROVISIONING THE TRAIN.

The provisioning of the train is an important matter. At the beginning of a trip

about 300 pounds of beef, 200 pounds of lamb, 125 pounds of ham, 250 pounds of chicken, 30 boxes of geese, 100 pounds of turkey, 150 pounds of fish, three bushels of clams, 25 pounds of lobsters, ten gallons of ice cream, a miscellaneous supply of vegetables, fruit, eggs, canned goods, cheese, sugar, flour, bread, crackers and similar articles are packed away in the refrigerator car.

Frequently, perishable goods must be taken on along the route, at points arranged beforehand, and the water and ice tanks must be constantly replenished. Ordinarily, a ton of ice is used daily.

THE WHITEHOUSE MESSENGERS.

The convenience of the members of the party is further attended to by "Whitehouse" messengers, who care for the baggage during the longer stops, and make such special arrangements as the party may desire. One of the important duties of these messengers is to check up the members of the party after each stop, to see that none is missing.

HOW AND WHERE THE WORLD GETS ITS MEAT

The task of furnishing the world with meat constitutes the largest industry in existence.

The United States furnishes more than one-half the world's supply of swine, more than one-third its cattle, and nearly one-seventh of its sheep.

NUMBER OF CATTLE, SHEEP AND SWINE IN THE WORLD.

There were in the civilized world in 1902, approximately 200,000,000 cattle and 450,000,000 sheep, and 125,000,000 swine, of which perhaps 25 per cent of cattle, 45 per cent of sheep, and 95 per cent of hogs were available for food-making.

The United States contained, in 1900, 69,438,758 cattle, 61,837,112 sheep, and 64,694,222 swine. In other words we furnish 34.72 per cent of the world's cattle, 13.74 per cent of its sheep, and 51.75 per cent of its swine, valued at $4,000,000,000.

CATTLE IN TEXAS, KANSAS, NEBRASKA AND ILLINOIS.

Texas has more cattle within its borders than any other state. In 1900, it had 9,426,196, Iowa recorded 5,367,630, Kan-

RANCH, NEAR THE SPRAGUE, CRAB CREEK, WASHINGTON.

sas 4,491,078, Nebraska 3,176,243, and Illinois 3,104,010.

The average value of all the cattle in Texas in 1900, according to the twelfth census, was $17.38, Iowa $26.50, Kansas $26.17, Nebraska $25.96, and Illinois $26.47. It is thus seen that the cattle of the other four states named averaged over 50 per cent greater in value than those of Texas, which is merely a breeding state, while the others feed the cattle brought from Texas and fit them for the market.

SHEEP IN WYOMING, MONTANA AND NEW MEXICO.

In sheep production Montana led, in 1900, with 6,170,483, closely followed by Wyoming and New Mexico.

HOGS IN IOWA, ILLINOIS, MISSOURI AND NEBRASKA.

Iowa headed the swine list, with 9,723,791. Illinois, Missouri and Nebraska respectively rank next as pork producers.

KILLING AND PACKING CENTERS.

In 1901, the receipts of cattle at the three great markets of the country were: Chicago, 3,213,220; Kansas City, 2,126,575; Omaha, 818,003. Of swine Chicago received 8,900,494; Kansas City, 3,716,404; Omaha, 2,414,052. Chicago led with 4,044,095 sheep, followed by Omaha with 1,314,841, and Kansas City with 980,078.

The Union Stock Yards and Transit Company, of Chicago, and similar companies in other cities do the receiving, weighing, feeding, watering and delivering to the buyer; the independent plants, which are practically tenants of the yards, do the slaughtering, refrigerating, manufacturing, curing, storing and shipping.

THE CHICAGO UNION STOCK YARDS. THE GREATEST SINGLE BUSINESS IN THE WORLD.

The business done at the Chicago Union Stock Yards is the largest single business in the world, and the entire industry has more than 45,000 employes and does an annual business of more than $500,000,000.

The old-time open cattle range is rapidly disappearing, with its immense herds of cattle, held by few owners, and is being replaced by fenced ranches and farms on which are grazed and fed cattle in smaller herds. This is more profitable as it obviates the heavy annual losses by freezing and

TEXAS LONGHORN—THE OLD-STYLE STEER.

starvation resulting from the old methods of handling. Irrigation has also helped materially to bring about this change. Almost the only extensive tracts of free open range now remaining are to be found in South Dakota, Montana, North Dakota, and parts of Wyoming and Colorado.

When the cattleman speaks of having his ranch cut up into pastures, the statement is likely to be misleading to the layman who is not familiar with the size of the Western pasture. Many a ranch pasture contains 100,000 acres.

THE LARGEST RANCH IN AMERICA.

Probably the largest ranch in America is owned by the organization commonly called The Capitol Syndicate, in the rich grazing country of Texas, which comprises 3,000,000 acres of land.

THE FAMOUS CATTLE WOMAN.

Altogether the largest ranch held by an individual owner is the property of a woman. It is more than 2,000,000 acres in extent and is the property of Mrs. Adair, of Paloduro, Texas.

For facts and statistics contained in the foregoing, the publishers of this volume are indebted to the Saturday Evening Post, of Philadelphia.

WESTERN FARMS OF GREAT EXTENT

In the Southwest, where farming pays more profitably than in any other part of the United States, farms ranging from 3,000 to 50,000 acres are found.

AVERAGE SIZE OF THE 5,000,000 FARMS IN THE UNITED STATES.

The average size of the 5,000,000 farms in the United States is 146 acres; in the

GREAT FARMS OF THE WEST.

GREAT WESTERN RANCH.

Southwest the average size is 500 acres. The largest ranches and farms are located in Texas, Oklahoma, Kansas, Indian Territory and Nebraska.

A FARM RANCH LARGER THAN THE STATE OF CONNECTICUT.

The famous X. I. T. farm, in the Panhandle of Texas, alluded to on the previous page, is more a cattle ranch than a farm, although recently about 20,000 acres has been sown to forage crops. This ranch covers 3,000,000 acres, and is larger than the whole state of Connecticut. It is owned by the Capitol Syndicate, of which the late ex-Senator C. B. Farwell of Illinois was at the head. It ships from 18,000 to 20,000 head of beef steers to the markets every year. It raises from 10,000 to 20,000 acres of corn and other forage crops to feed these cattle.

"X. I. T." FARM EMPLOYS 200 COWBOYS AND 50 FARM HANDS.

Two hundred cowboys and fifty farm hands find employment on the ranch. The income of the ranch is nearly $1,000,000 per year.

LARGEST FARM IN THE SOUTHWEST.

Colonel C. C. Slaughter of Dallas, Texas, owns 1,250,000 acres of farm and ranch land in Texas.

The largest farm in the Southwest is the "101" ranch in Northern Oklahoma. This covers 50,000 acres, of which a greater part is cut up into fields. The expenses of the ranch are $75,000 every year. Most of the crops are given a double sowing, that is, each field is twice utilized during the growing season. Some years this ranch clears $150,000. It has 8,000 acres in wheat, 3,000 to 5,000 acres in corn every year, and an equal amount of millet and kaffir corn. Two hundred men work on the ranch in harvest time and thirty the year around. Experts are employed in every department. Eight thousand head of cattle are shipped from the ranch every year. None of the cereals except the wheat is sold from this ranch.

50 BINDERS AND 150 MEN AT WORK IN ONE FIELD.

During the harvest season it is common enough to see fifty binders, one following another, cutting down the ripening grain and from 100 to 300 men at work in one field. Plowing is done by steam power, and once commenced the big engines pull the plows night and day. This is the only ranch in the United States where nights and Sundays are not observed during the harvesting seasons.

CONDUCTED BY TELEPHONE.

A telephone system connects the entire ranch, and the foremen know exactly the work being accomplished.

FINEST FARM IN THE UNITED STATES.

Another immense ranch is the Forsha in Central Kansas. It covers 5,000 acres and is the finest equipped farm in the United States. Upon this farm are a flouring mill, a weather bureau, a postoffice, a gas plant, long-distance telephone and other modern conveniences. The ranch house contains eighteen rooms, bath-rooms for the men, a billiard room, a library and ballroom.

By courtesy of the Detroit Photographic Co.
SHOWING THE BRAND.

1,500 ACRES OF ALFALFA IN ONE TRACT.

Mr. Forsha has the largest field of alfalfa in the United States, 1,500 acres in one tract. He generally cuts three crops from this field. He grinds the wheat from his own fields into flour, shipping the flour all over the United States. He also buys wheat from adjacent farms and makes that into flour also. A daily weather record is kept on the ranch for the government. The owner's house is heated by steam and lighted by gas.

FARM OF ROCKEFELLER.

Frank Rockefeller owns 14,000 acres of fine grazing and farming land in the valley of Soldier Creek, in Western Kansas. He has about 5,000 acres under cultivation; the remainder is converted into alfalfa and timothy hay pastures. This ranch contains some of the finest bred Hereford and Shorthorn cattle in the world. These cattle are fed upon ground grain, grown and milled upon the ranch. Thirty expert cattle raisers are constantly employed to care for the blooded stock and as many more work in the field. The cattle and horse barns are of steel and stone.

Mr. Rockefeller is now irrigating the upland fields, and proposes to convert the 91,000 acres of pasture land into one gigantic alfalfa field, making the largest tract of alfalfa in the country.

EXTENSIVE RANCHES IN THE GREAT GRAIN BELTS.

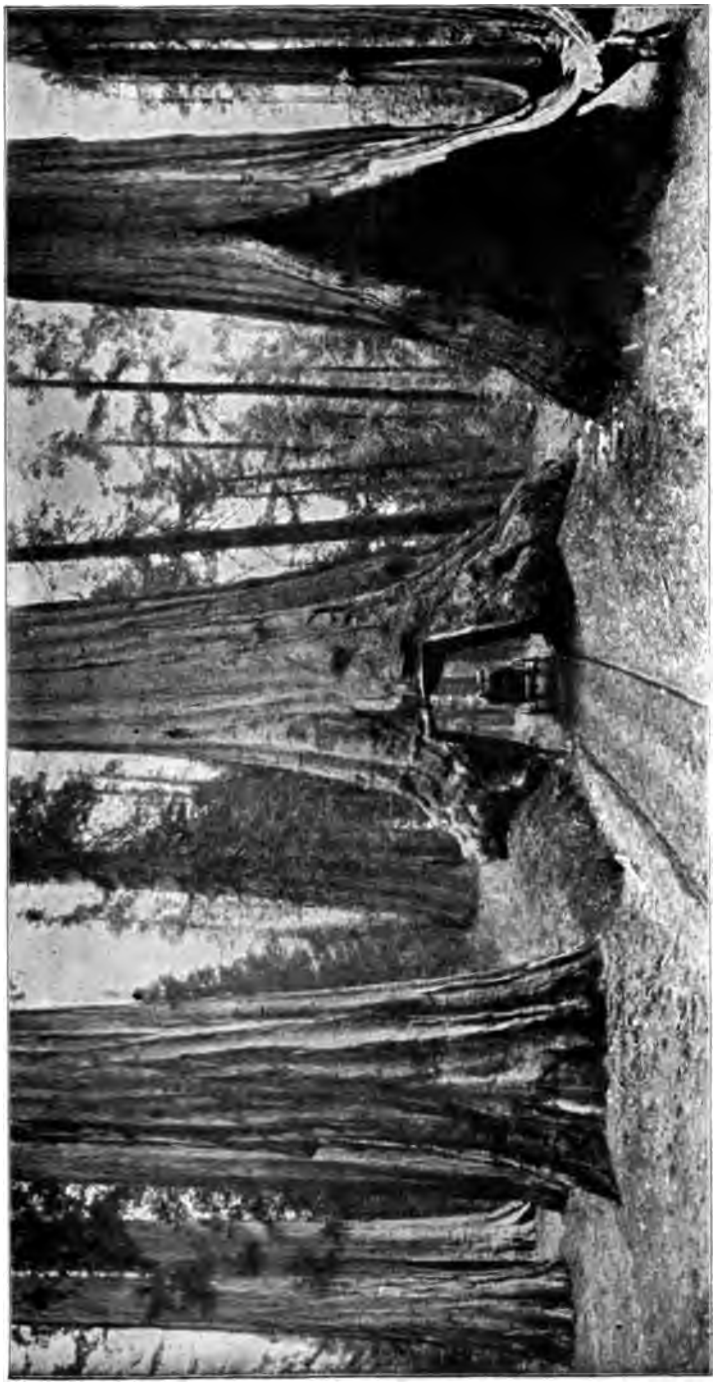
Extensive ranches are the rule in the great grain belts. It is nothing uncommon for one farmer to come to an implement office and buy fifteen harvesters, a dozen plows and a dozen corn harvesters. Fifty men at work on one farm is the average size harvesting crew. Farmers who pay taxes on $50,000 worth of agricultural land may be counted by the dozen during the tax-paying time. It is an ordinary event in the freight offices of western railway companies to receive orders from farmers to place railway sidings in their farms during the fall for the shipment of grain. These orders are generally recognized and filled because the grain shipments are immense.

By courtesy of the Detroit Photographic Co.

BRANDING A STEER.

COWBOYS OF NEW MEXICO.

BIG TREES OF CALIFORNIA



BIG TREES OF CALIFORNIA.

In the state of California stand the oldest living things of the world — the "big trees."

THE CALAVERAS GROVE

About the middle of the last century, the Calaveras Grove of "Big Trees" was discovered, and after considerable examination by scientists, its members were classified as a bona fide species of the genus Sequoia. This species, with its kinsman, the Redwood, has no close relatives on earth, although both resemble the cypress. Only by comparison of the living trees with various fossils, was it discovered that the Sequoias belong to a very old family which dates back to the moist days of the Miocene period, when all vegetation grew abundantly. At that time, it is supposed, these trees covered much of Europe and America, well up toward the north pole. With the visitation of the glacial era, came the complete extinction of much vegetation, and when the ice receded, possibly, these very coast Redwoods and "Big Trees" fortunately were left uninjured.

This was all thousands of years ago, and to-day, in the specially favorable localities where these old trees have stood for so many centuries, they impress us as almost the only survivors of a previous geological age.

THE REDWOOD FORESTS.

In the seaward ravines and slopes of the coast range which traverses California, stand the forests of Redwood. From just over the Oregon line down into Monterey County, California, the members of the gigantic tree tribe thrive only so far inland as the sea fog always sweeps—about 20 miles.

TEN SEPARATE FORESTS—AREA 260 MILES LONG.

On the slopes of the Sierras, scattered through the timber land of that region, in sheltered valleys, stand the ten separate forests of "Big Trees"—the only ones in the world. The area covered by these trees is not over 260 miles in length.

In all, there are but a few hundred fairly large trees.

FIVE HUNDRED TOWERING SKYWARD.

Among these, the truly great ones do not number over 500. They are found set in mountain forests of great richness and grandeur. These forests are evergreen. The "Big Trees" are found in company with big Sugar and Yellow Pines, Firs and Cedars, which, themselves, rise from 175 to 200 feet in height. Above these tower, some hundred feet higher, the great crowns of the Calaveras Grove. A Sugar Pine ten feet through is a rarity, yet there are Sequoias of the Mariposa Grove 30 feet through, and many of them are 10 to 20 feet thick. Many of these trees when felled are big enough to accommodate a troop of cavalry on horseback.

A TREE 4,000 YEARS OLD.

As to the age of these giants there is some uncertainty. Through counting their rings, some, 2,200 years old, have been found.

One, that fell before the wind, was 4,000 years old. It is supposed that some of the trees now standing are 5,000 years of age. In fact, it has been said of them that, barring accidents, they are immortal. Part of this longevity is due to the fact that the Sequoias have a thick, fibrous bark that is all but fireproof, and thus affords protection from the numerous fires that kill smaller trees and vegetation. Also this bark prevents to a great degree the deadly effects of fungus growth, which lodges in scarred trees and rots back into the wood.

THE BIG TREES' ENEMY.

One enemy has the Sequoia, and that is the lumberman, who is cutting down this noble tribe of trees for commercial use. By far the greater number are held in private ownership, although some of them are in forest reserves.

THE MARIPOSA GROVE.

The Mariposa Grove is owned by the state of California and is thus secure. But many other groves are rapidly falling. The trees do not multiply to any extent despite their superb strength. In the Calaveras Grove there are some trees 40 years old, but aside from these there is little sign of increase save in the limited area on the south fork of the Kaweah and the Tule rivers, where, although restricted, there is an abundant growth of trees of every age. Doubtless, action will be taken ere long to preserve to future generations the finest specimens of the old sentinels of the ages.

WHERE THE VARIOUS AMERICAN INDUSTRIES ARE MAINLY CARRIED ON

The United States Census Bureau has issued a report indicating the places where many of the most important of American industries are concentrated. Measured by the value of products, these points are as follows:

COLLARS AND CUFFS.

More than 85 per cent of the collars and cuffs are made in Troy, New York.

OYSTER-CANNING.

More than 64 per cent of the canning of oysters is done in Baltimore.

GLOVES.

More than 54 per cent of the manufacture of gloves is carried on in the adjoining cities of Gloversville and Johnstown, New York.

COKE.

More than 48 per cent of the coke supply comes from the Connellsville district in Pennsylvania.

BRASSWARE.

More than 47 per cent of the brassware in the United States is made in Waterbury, Connecticut.

CARPETS.

More than 45 per cent of the manufacture of carpets is carried on in Philadelphia.

JEWELRY.

More than 45 per cent of the manufacture of jewelry is carried on in Providence, Rhode Island, and the adjoining towns of Attleboro and North Attleboro, Massachusetts.

SILVERWARE.

More than 36 per cent of the silverware manufacture is done in Providence, Rhode Island.

MEAT INDUSTRY.

More than 35 per cent of the slaughtering and packing business is done in Chicago.

PLATED AND BRITANNIA WARE.

More than 32 per cent of the plated and Britannia ware is made at Meriden, Connecticut.

AGRICULTURAL IMPLEMENTS.

More than 24 per cent of the agricultural implements are made in Chicago.

SILK.

The whole of the silk manufacture in the United States is conducted in Paterson and West Hoboken, New Jersey.

PACKING HOUSE EMPLOYES IN SOUTH OMAHA.

The number of wage earners engaged in slaughtering and meat packing in South Omaha, Nebraska, constitutes 90 per cent of the total number employed in all industries in that city.

IRON AND STEEL.

The iron and steel industry forms 89 per cent of all the industries in McKeesport, Pennsylvania.

POTTERY.

The pottery manufacture constitutes 87 per cent of all business in East Liverpool, Ohio.

FUR HATS.

The fur hat industry forms 86 per cent of all manufactures in Bethel, Connecticut.

GLASS.

In Tarentum, Pennsylvania, the glass manufacture makes up 80 per cent of all business done there.

COTTON GOODS.

In Fall River, Massachusetts, the manufacture of cotton goods constitutes 80 per cent of all business done there.

BOOTS AND SHOES.

In Brockton, Massachusetts, the boot and shoe manufacture forms 77 per cent of all business done there.

PUBLIC SCHOOLS OF THE UNITED STATES—AT HOME AND ABROAD

While the system of public schools in the United States has often been the subject of favorable comment, few people stop to consider the enormous work and the amount of money spent in this great public work.

NUMBER OF PUPILS.

The annual report of the Commissioner of Labor shows that during the year ending June 30, 1902, the grand total of pupils in public and private schools of our country was 17,299,230, an increase of 278,520 pupils over the preceding year. Of this number, 15,710,394 pupils were enrolled in institutions supported by general and local taxes imposed by states and municipalities.

VALUE OF PUBLIC SCHOOL PROPERTY.

The value of the property used for public school purposes was $756,043,089, an increase from $130,380,008 in 1870.

EXPENDITURES FOR COMMON SCHOOLS.

Expenditures for common school purposes, including elementary and secondary schools but excluding higher grades, amounted to $226,043,236, having risen from $64,396,666 in 1870.

EXPENSE FOR SCHOOLS PER CAPITA.

The expense for schools per capita of population increased from $1.64 in 1870 to $2.93 in 1902. The amount expended per capita varies much in different states. It is $4.65 in California, $5.30 in Nevada, $5.18 in Colorado, $4.93 in Massachusetts, and $4.60 in New York. The rural populations generally expend less. The number of high schools supported by public money in 1901 was 6,318.

SCHOOLS IN THE NEW ISLAND POSSESSIONS.

The recent extension of our national rule over some of the islands of the Orient involves the imparting of knowledge under governmental supervision to multitudes of untaught children in those far-away insular possessions. The expense of the new educational system in the Philippines is mounting up to a high figure.

A SMALL ARMY OF TEACHERS.

"Uncle Sam" has already appointed a small army of teachers and has stationed them in all parts of the archipelago, with instructions to saturate the young barbarians as thoroughly as possible with Ameri-

can ideas and information. Above all, they are to be taught English, and immense quantities of schoolbooks in that language—geographies, arithmetics, readers, etc.—have been shipped across the ocean for their use, together with slates and pencils, pens and copy-books, blackboards and chalk, maps and globes and other such apparatus ad libitum.

UNDER SPANISH RULE.

Under Spanish rule the educational system in the islands was exceedingly primitive. Girls were taught embroidery and needlework, but were not supposed to require other knowledge.

Schooling ordinarily ended with the tenth year of the pupil, and teachers were so poorly paid that their calling was looked down upon.

SCHOOL ATTENDANCE COMPULSORY IN THE PHILIPPINES.

The first act of the Philippine commission when it turned its attention to the work of education was to make schooling compulsory, while free of cost, so as to bring it within reach of the laboring classes and the poor. School attendance is obligatory on all native children between the ages of six and twelve years.

OPEN 1,500 SCHOOLS IN THE ARCHIPELAGO.

Since then the archipelago has been divided into seventeen educational districts, with an American school superintendent in charge of each. One thousand American teachers for primary work have been appointed and assigned to stations in the various towns, with 200 additional teachers in higher branches. Besides these 3,400 Filipino teachers have received appointments, and provision has been made for instruction in the English language in 1,500 schools, in which over 200,000 children are enrolled. Night schools for adults and others unable to attend during the day have been opened throughout the islands.

FILIPINO TEACHERS.

The Filipino teachers get one-half the salaries of the American teachers, who are paid from $1,000 to $1,200 per annum. Trade schools in the large towns have been organized. A number of agricultural schools will soon be in operation, and, as a means of preparing the natives for employment in the signal corps, telegraphy is now being taught.

The Filipinos are to be educated in schools organized on the American plan. Rebellious natives may lay down their arms only to take them up again later, but the present generation is learning English and singing "The Star-Spangled Banner," and will not be in the least disposed to indulge in insurrection. Already schoolhouses are being built everywhere and everybody tries to speak English.

AMERICAN SCHOOL BOOKS—750,000 SENT TO THE PHILIPPINES.

American school-books to the number of 750,000 have already been shipped to the Philippines, together with enormous quantities of school supplies, including 20,000 modern school desks. At present most of the children have to sit on benches without backs.

YEARN FOR KNOWLEDGE.

The Filipino children are noticeably bright and precocious, learn rapidly, and teach their parents English. One teacher reports that he can more easily govern 300

Filipino children than fifty young Americans.

GAMES OF THE YOUNG FILIPINOS.

The native boys are most fond of football, leapfrog, pitching pennies and flying kites, introducing the element of gambling wherever possible. Of the games introduced by the American teachers they take most interest in baseball, hop-scotch and prisoner's base. The girls enjoy running games, song and dance games and jack-straws, but the American teachers have introduced among them blindman's-buff, hide-and-seek, jumping the rope, crack the whip and the dressing of dolls.

FIRST FILIPINO GRAMMAR.

The oddest of all educational volumes is the Filipino grammar—the first one to be issued—which has just made its appearance. It has three primitive, vowel sounds—a, i and u—which seem to be of European origin. The other vowel sounds —e and o—are used chiefly in printing and in words of Spanish origin, but they are pronounced like "i" and "u" respectively.

THE TANGALOG ALPHABET.

The tangalog alphabet is an easy one. There are only 15 simple and two compound sounds, but quite enough for the vocabulary of a Filipino. Adjectives are generally formed by prefixing "ma" to the root. Comparison is expressed by duplication, thus: "Mabuti," good; "Mabubuti," best. The same simple method is in use in expressing the various moods and tenses of verbs. Thus the root, "aral," means study; "mag-aral," to study; "mag-a-aral," I study; "mag-a-aral aco," I shall study.

THE AMERICAN SOLDIERS WITH FILIPINO CHILDREN.

HOW THE UNITED STATES GOVERNMENT EDUCATES THE INDIAN

GOVERNMENT SCHOOL AT CARLISLE, PA., WHERE GOOD WORK IS BEING DONE.

The policy of the government in past years of selecting a few Indian youths from each tribe and removing them to distant schools, there to be given, free of cost to the Indian, all the advantages that American youths pay for, either in money or work, seems in the end to turn out unfortunately for the Indian himself. The youth is weaned from his old associations, and accustomed to a life of luxurious ease. After his education is completed, there remains no course open to him but to return to his old tribal relations, the very life that his training has unfitted him for.

METHOD SPOILS THE INDIAN.

The government does not provide a career for him as it does for graduates of West Point and Annapolis. All he can look forward to must come from his tribe. He returns to the reservation, where he is not even given land in severalty, in case he should wish to support himself by tilling the soil. He is not given any occupation or office; even his rations are dependent on his being recorded on the family ration ticket. To live in peace with the tribe, he must not appear to put on airs. If he tries to adopt the customs of civilization he is a subject for ridicule and ostracism, until he submits and falls back into the old, filthy life of the tepee.

WRETCHED CONDITIONS ON SOME RESERVATIONS.

The miserable condition of the Indians on some of the reservations is a reproach to the American people. In some cases, the school facilities are not sufficient for more than one in ten of the children of school age. No churches or missionaries are provided, and on Sundays the Indians play cards and the troops at the post play baseball as well as cards.

AN ANOMALOUS STATE OF THINGS.

Sometimes very anomalous conditions exist, as when a troop of infantry is sta-

tioned on an extensive reservation to keep in control thousands of mounted braves; or when a cattle company pays pasturage for ten thousand head of stock on a reservation, and actually pastures forty thousand head; or when the rations are reduced in a year of drouth to half the quantities issued in previous years, or when white settlers have taken out irrigating water from above the reservations, thus depriving the Indian irrigators of the means of raising crops.

CAPABLE OF SELF SUPPORT.

Many more of the Indians are able and willing to become self-supporting if given land in severalty, and provided with means of irrigating it. As common laborers on railroad construction, they have proven superior to the laborers from Europe.

CHOCOLATE MAKING IN AMERICA

Chocolate making has become one of the great industries of America. When, one day, shortly after the fall of his kingdom,

COCOA TREE.

Montezuma raised a golden cup to his lips, for refreshment, he introduced a new drink to the world, and that beverage was chocolate.

CONQUERORS CARRY THE DARK-BROWN NUT HOME TO SPAIN.

Bernard Diaz, one of the Spanish officers with Cortez, observed the monarch, and in the history he afterward wrote of the conquest of Mexico, he described the king's act and its effect. Thus it came about that when the Spaniards took ship for Cadiz, they bore with them not only a yellow metal but a dark-brown nut from which chocolate was made.

KNOWLEDGE OF CHOCOLATE MAKING SPREADS THROUGH EUROPE.

This knowledge of chocolate making by the Spaniards was kept a secret for many years, but it finally crossed the Pyrenees into France, and spread throughout Europe. The manner in which the fame of the beverage was diffused is interesting. In the refectories of the Spanish monasteries chocolate had become such a favorite beverage that the monks, wishing to remember their brothers in France in an especially friendly way, sent them presents of the cocoa beans.

PURITANS BRING IT TO MASSACHUSETTS BAY.

Thus it was that when the daughter of Philip III. went to Paris as the wife of

Louis XIII., she bore with her from Madrid the news of the new drink from America. Next the Puritans took it with them to Massachusetts Bay. Since then, chocolate has become a household word in the length and breadth of the United States.

FIRST CHOCOLATE MILL IN AMERICA—1765.

The first chocolate mill was established at Dorchester, Massachusetts, in 1765. This mill, 15 years later, became the property of Dr. James Baker. Later, the establishment passed into the control of Walter Baker. Others afterward succeeded both Bakers, and a man named Pierce, in this concern.

CONSUMPTION OF CHOCOLATE AND COCOA IN THE UNITED STATES.

In 1860 there were consumed in the United States 1,181,054 pounds of chocolate and cocoa. In 1902, the consumption had grown to 48,785,688 pounds, a stupendous increase of 4,030 per cent in 42 years. During the same period, the population of the country increased only 151 per cent. But what of the product itself?

CHOCOLATE MILL AT MILTON, MASSACHUSETTS.

To drive down the hill from Milton, Massachusetts, past the chocolate mills, is to inhale deep aromatic odors, that lead you to imagine that you are skirting the domains of "Araby the Blest." Within the mills there is a "spick" and "spanness" that make the aroma even more delicious, for they seem to fill it with a fresh and wholesome cleanliness. The whole theory of the process in the mills is that the cocoa bean is a product of nature, and that what it needs is refining and purifying, just as gold needs refining to be brought to the pure ingot.

THE COCOA TREE AND NUTS.

Chocolate is obtained from the cocoa tree, a tropical plant which reaches a height of between 20 and 30 feet. It bears pods about nine inches long, within which are closely packed the beans. These are about the size and shape of almonds, and of a brownish color, when dried. They come to market in burlap bags, and on the lower floors of the great mills, the first step in purification is taken by cleansing the beans from any dust or foreign particles that may have become attached to the shells.

THE PROCESS OF MANUFACTURE.

Next comes the roasting, a most important operation, upon which depends to a great extent the flavor of the beans. Too little roasting leaves them crude and underflavored, while too much tends to make them bitter. This process is carried on in the upper stories of the mills, the cleansed seeds being put into large cylindrical roasters, holding a ton each. These machines keep the seeds in constant motion over hot pipes, for about three hours. When they are "done to a turn" they are dropped through big hoppers to the floor below; there they are broken into small fragments. The shells, already loosened by the roasting process, are then removed by ingenious winnowing machines, where the bean fragments are fanned within screens, and the light shells neatly separated from the solid fragments of the beans.

COCOA SHELLS.

The manipulation of these winnowing machines requires experience and care, for a workman may easily blow away his salary by admitting too much current to the fans. These shells, once separated, are ready to be

packed in boxes and placed on the market. Cocoa shells are well-known and widely used, making a palatable and inexpensive drink, with a slight flavor of chocolate about it.

GRINDING THE CRACKED COCOA.

The cracked cocoa, freed from the shells, is now destined to be turned into chocolate without further ado. This is accomplished by a process of grinding. From the winnowing floor the cleaned fragments drop another story, again through capacious hoppers, down to the great grinding rooms. Stretching away in seemingly endless ranks, stand big, gleaming, intricate machines, which receive the cocoa beans as they are fed into the hoppers above, and grind them into a fine, smooth paste or thick liquid.

MOLDING THE CAKES.

As this liquid flows thickly out at the bottom of the burnished grinder, it falls, if it is to be a plain chocolate, into oblong molds, which give it the form familiar to housekeepers. It is now in the molds, but not yet molded. For that purpose, it must be carried into a room which seems to be nothing but noise. This is the room of the automatic molders. If the chocolate were pressed into the molds, it would merely stick to the presser mold and all; so, instead, it is shaken in. The pasty lump of chocolate in its metal mold is put into a wooden tray on a table, which is shaken by steam, and makes the molds bob up and down in a most deafening manner. After the chocolate is fitted to the mold, it is carried off to the cooling rooms.

SWEETENING AND FLAVORING.

In making sweetened chocolate, pure sugar is added in a certain proportion, before molding, and also the finest quality of vanilla beans, if it is to be vanilla chocolate. In the manufacture of breakfast cocoa, a portion of the oil of the chocolate bean is removed by hydraulic pressure, and the pressed mass remaining is ground into minute particles. This process is continued until a high degree of fineness has been obtained.

CINNAMON

The cinnamon plant or tree is raised most readily from seeds, although the finer kinds are propagated in Ceylon by layers. The wood of the tree is light. The branches are thick and spreading, and shoot forth horizontally or inclining downwards, with numerous oblong leaves growing in pairs opposite to each other. The cinnamon berry is small and has the form of an olive, with a kernel.

It adheres to a thick green and hexangular receptacle in the manner of an acorn. The peeling process commences early in May and continues until late in October. Two longitudinal slits are made in the bark, which is gradually loosened with the convex side of a knife, and then half of its circumference usually comes off in one entire slip. The epidermis, together with the greenish pulpy matter immediately under it, is carefully scraped off. When sufficiently dry, it is made up into bundles weighing about 30 pounds each. Ceylon alone has 37,000 acres of land devoted to the cultivation of cinnamon. It is grown to some extent in China, and several species of the plant in a wild state are found in Java.

ALASKA

Alaska is eight times as large as all New England. It has a coast line of 26,000 miles. It has the best yellow cedar in the world. It has the greatest salmon fisheries. It has cod banks that excel those of Newfoundland. It has the largest river in the world.

THE YUKON RIVER.

The Yukon is 20 miles wide, 700 miles from its mouth. With its tributaries, it is navigable for 2,500 miles. It discharges one-third more water than the Mississippi.

VAST EXTENT OF ALASKA.

The territory of Alaska has an area of 329,529,000 acres, of which 272,000,000 acres lie within the temperate zone. In 1867, the United States Government paid for this area $7,200,000. One Alaska company alone has paid to the United States Government $7,000,000 in rentals and royalties. The value of Alaska salmon packed in 1901 was over $7,000,000.

TRADE OF ALASKA.

The experience of the world shows greater trade in the temperate zone than in the tropics. Annual exports to Alaska amount to $1,000 per head. Annual imports from Alaska amount to $400 to $1,000 per head. Alaska is the American Sweden and Norway. It begins in a line within Southern England. Alaska does not extend as far north as Northern Norway. It is richer than Sweden and Norway.

By courtesy of the Detroit Photographic Co.

STAGE COACHES STARTING FOR THE MINES.

KILLING, SKINNING AND CUTTING UP SEAL IN ALASKA.

THE ISLAND OF KADIAK.

Kadiak, on the coast, is in the same latitude as Aberdeen, Scotland. The lowest temperature ever recorded at Kadiak was five degrees above zero. The average winter temperature at Kadiak is higher than at Washington, D. C.

TEMPERATURE AND PRODUCTS.

The lowest temperature ever recorded at Dutch Harbor, Alaska, was nine degrees above zero. Dutch Harbor is in the latitude of Liverpool. Sitka has not cold weather enough in winter to supply ice for the summer. Alaska is rich in minerals, lumber, fisheries, furs and coal. The trade with Alaska is now nearly twice as great as with Hawaii.

SEAL AND WALRUS HUNTING.

Quite as much trouble has been caused between the United States and British governments over the indiscriminate hunting of seals in Alaskan territory as over any international question. One of the first laws enacted by this government after its purchase of Alaska from Russia, for $7,200,000, was aimed to prevent the slaughter of mink, marten and fur seal in that territory.

BREEDING GROUNDS OF THE SEAL.

The breeding grounds of the seal which is of commercial value are principally the Pribilof Islands of St. Paul and St. George.

This land was leased by the Alaska Commission Company for $60,000 a year, and a commission, or royalty, of $2 on every fur seal taken. The company was limited to 100,000 seals a year.

ILLEGAL HUNTING.

This arrangement made by the Treasury Department was considered very favorable until the great movement of settlers west tempted pelagic sealing or hunting for fur seals in the water. So rapidly did the herds of seal begin to diminish that officials were alarmed, and in 1886, the revenue cutter, Corwin, was sent to the territory and three British vessels were seized for illegal hunting. This caused a great uproar, and a demand was made by Great Britain that the sailors be released. This was done, but, the next year, a similar proceeding followed.

JOINT AGREEMENT WITH GREAT BRITAIN.

After much discussion and legislation, a joint high commission was appointed between Great Britain and the United States and the outcome of its work was a proposed set of regulations to protect the seals. These regulations, which were to continue in force until either party violated them, prohibited the killing (except by Indians) of seal within 60 miles of the Pribilof Islands at any time, and anywhere in the North Pacific from May 1 to July 1, of each year. This closed season allowed the seals time to cross from their winter quarters over the ocean to the Pribilof Islands to breed. Explosives and firearms (except shotguns) were prohibited in hunting. This stipulation, however, was not ratified, and the United States government was forced to prevent sealing on the Pribilof Islands except by the North American Commercial Company and to demand papers showing a complete record of every sealskin brought into our ports. This was a hard blow to Canadian interests, and tended to suppress pelagic sealing.

PELAGIC SEALING.

In pelagic sealing, the hunters sail in schooners from our shores to Yokohama and thence bear down upon the animals in the sealing ground. The cry, "Sleepers", is the warning given by the lookout on shipboard that seals are in sight. A boat is lowered, provisioned for five days, and equipped with shotguns and shells. When the seals are espied they are asleep on their backs, with their flippers across their bellies. Stealthily, the hunters slip upon their quarry and shoot them asleep. Great quiet must be preserved until the killing begins, for, although the seals are almost blind, they have an acute hearing. At the Pribilof Islands, the government has built fences to confine the bull seals during breeding seasons.

WALRUS HUNTING BY THE ESKIMOS.

Walrus hunting is carried on in the Arctic seas by the Eskimos and is a very profitable but dangerous enterprise. The method pursued by these little people of the North is to cruise about the sea, and when a walrus is sighted, to lower a whaleboat with about six men in it. Gently they steal upon the unsuspecting walrus, and when they come within about 20 yards of the animal, it is harpooned. The harpoon has a handle attached at one end, and on the sharp end is a movable barb. To the barb is attached a rope, which jerks the barb to a horizontal position when the spear is buried in the animal. This prevents the harpoon from drawing out. Now the walrus is enraged and tries to break away. It swims

with all its might and the natives shoot it with bullets from a Winchester rifle. So thick skinned is the animal that one shot will not suffice, and six or seven shots are often necessary. All this time it swims strongly. Finally, it can be drawn near enough to the boat to be stabbed with a lance through the heart and lungs. It is then towed to the ship and hoisted on board by means of pulleys. Here it is cut up. These great animals have valuable tusks and blubber, and average about 1,800 pounds each, in weight.

FLORIDA'S PRODUCTS AND PLEASURE RESORTS

Northern people go to Florida, from November to April, to spend money. Sunshine, soft breezes, flowers, and singing birds are a vast improvement on raw winds, alternating frost and thaw, and mud and misery.

FOUR HUNDRED MILES OF OCEAN BEACH.

The favorite resorts of Florida are on the east coast, where are the Halifax and Indian rivers, formed by flinging out an arm of sand into the great waters of the Atlantic and turning a section of the deep into an inland sea. The ocean beach of Florida, stretches north and south, more than 400 miles.

NORTHERN CAPITAL MAKES IMPROVEMENTS.

Northern capital alone has made the improvements which, in conjunction with natural elements, constitute the attractive features of Florida's pleasure resorts. Most of the expenditure in this direction is represented by capacious and superb hotels at various well-known points, which owe their construction to a single man.

ST. AUGUSTINE AND THE "PONCE DE LEON."

At St. Augustine, this man of comprehensive entertainment, built the Ponce de Leon, and when this luxurious and beautiful structure is opened for the season, the ancient town, over whose time-begrimed fortress the ensigns of three different nations have successively waved, celebrates the event with processions, the booming of cannon and a profusion of flags.

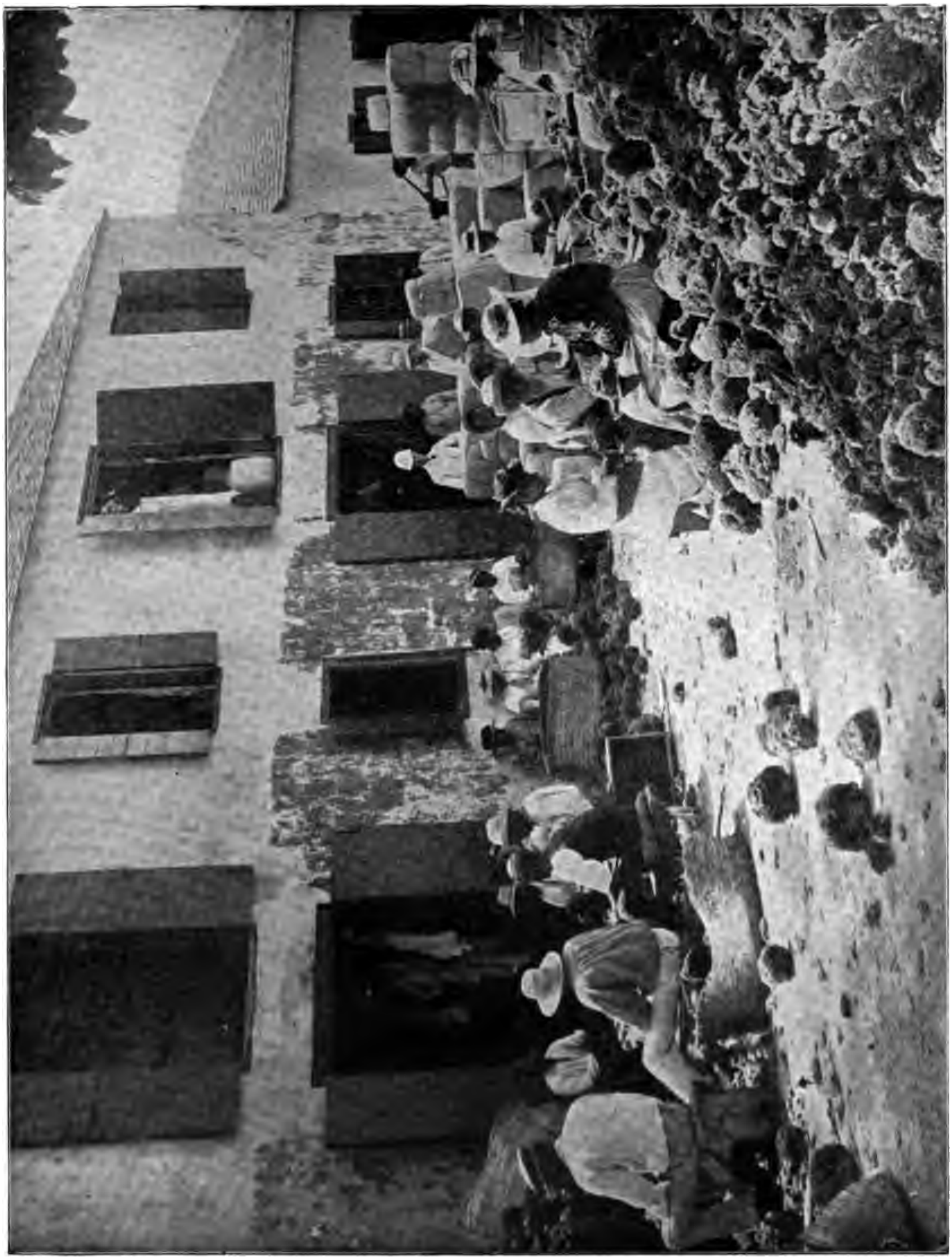
PALATIAL HOUSES OF ENTERTAINMENT.

The Alcazar and Cordova, at St. Augustine, owe their origin to the same man, and later he added the Ormond, on the Halifax, the Royal Poinciana and Breakers, at Palm Beach, the Royal Palm, at Miami, and the Colonial, over at Nassau—all sumptuous and palatial.

THE "ROYAL POINCIANA."

The greatest, however, is the Royal Poinciana, at Palm Beach, a place which this modern Crœsus has made the most beautiful spot on earth.

On one side is Lake Worth, on the other the Atlantic, and over the stretch of sand between are groves of cocoanut palms and palmettos, avenues of Australian pine and oleanders, and gardens of glorious hued flowers. When all this tropical foliage is bathed in Florida sunshine, gleaming and glad; when the Neapolitan Orchestra goes out under the palms and the guests gather



SPONGE FACTORY—KEY WEST, FLORIDA.
An Important Industry about which few people are informed.

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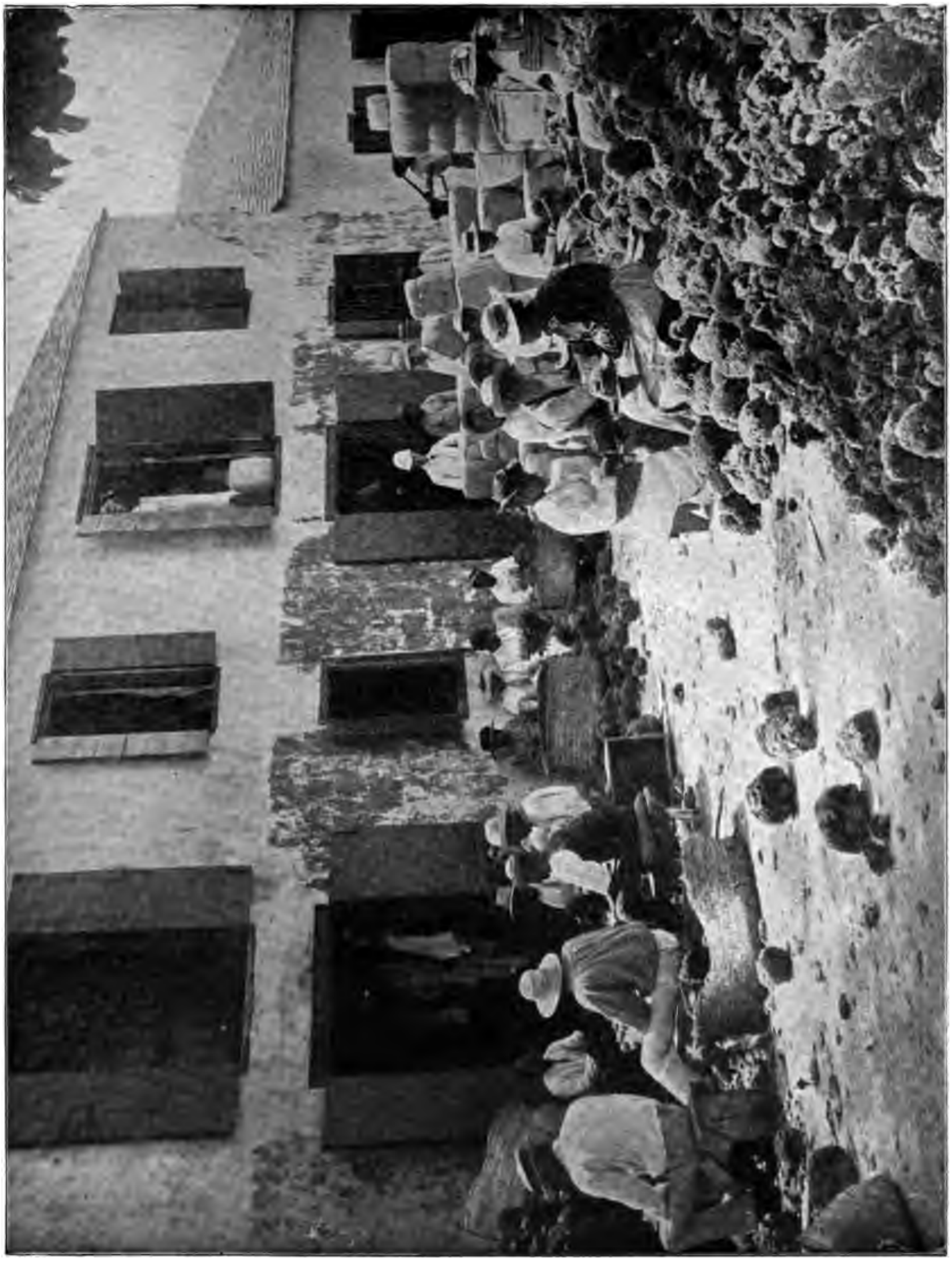


SPONGE FACTORY—KEY WEST FLORIDA.

An important Industry about which few people are informed.

PALM BEACH, FLORIDA, AS IT APPEARS TO THE TOURIST.

for the afternoon concert, and that heavenly music floats out upon the breezes which come in fresh and sweet from the sea; when the cocoanuts cling close to the strong stems above and great plumes of green sway across the blue beyond, their grateful shade sheltering the throngs of beautifully gowned women below, whose toilets are in pretty pink and purple of the flowers; the scene is certainly very fairylike. It has been called "Paradise" so often that the term is trite. But one could weave many a vision of fancy together and find them realized here.

PALM BEACH.

To see it is to understand why Palm Beach has become the center of attraction for that procession of wealth and aristocracy which moves southward in search of rest, pleasure or new excitement. Nearly the whole generation of millionaires flocks here. It dazes one to look over the list of names sometimes registered at Palm Beach—the Astors, the Vanderbilts, the Goulds, the Castellanes, the Manchesters, the Stillmans, the Benedicts, the Joneses, the Harrimans, the Van Rensselaers, the Clarkes, the MacVeaghs, the Wanamakers, the Schofields, and a score or more of others. Nowhere else are so many millionaires housed and huddled together on one little strip of land.

PRODIGAL EXPENDITURE.

Of course money flows like water. It hardly seems to be money, but is flung out with a freedom which is equaled only by the eagerness with which it was grasped in the making. At high tide, which was reached about the last of February this year, the Royal Poinciana had some 1,400 guests, and the daily income could hardly have averaged less than $10 per guest. The employes and help of the great establishment number 1,100 persons, and the cost of food alone is $2,200 per day.

It nearly all comes from the North, and hence means little to Florida. Cars are sidetracked at the kitchen doors and the supplies go straight to the pantries and refrigerators. The dining-room covers about two-thirds of an acre, seating 1,700 people, and the corridors and halls measure more than two miles. It is the largest hotel in the world.

The railroad built by the owner of these mammoth hotels has opened up the garden spots of the east coast.

THE ORANGE GROVES AND PINEAPPLE FIELDS.

The Indian River orange groves produce the finest flavored fruit sent to market, and the pineapple fields on the same river, near Forts Pierce and Eden, are very prolific. One of the farmers of that section says that if he gets only two crops in five years it is still a profitable business. An acre of ground has yielded as high as $900.

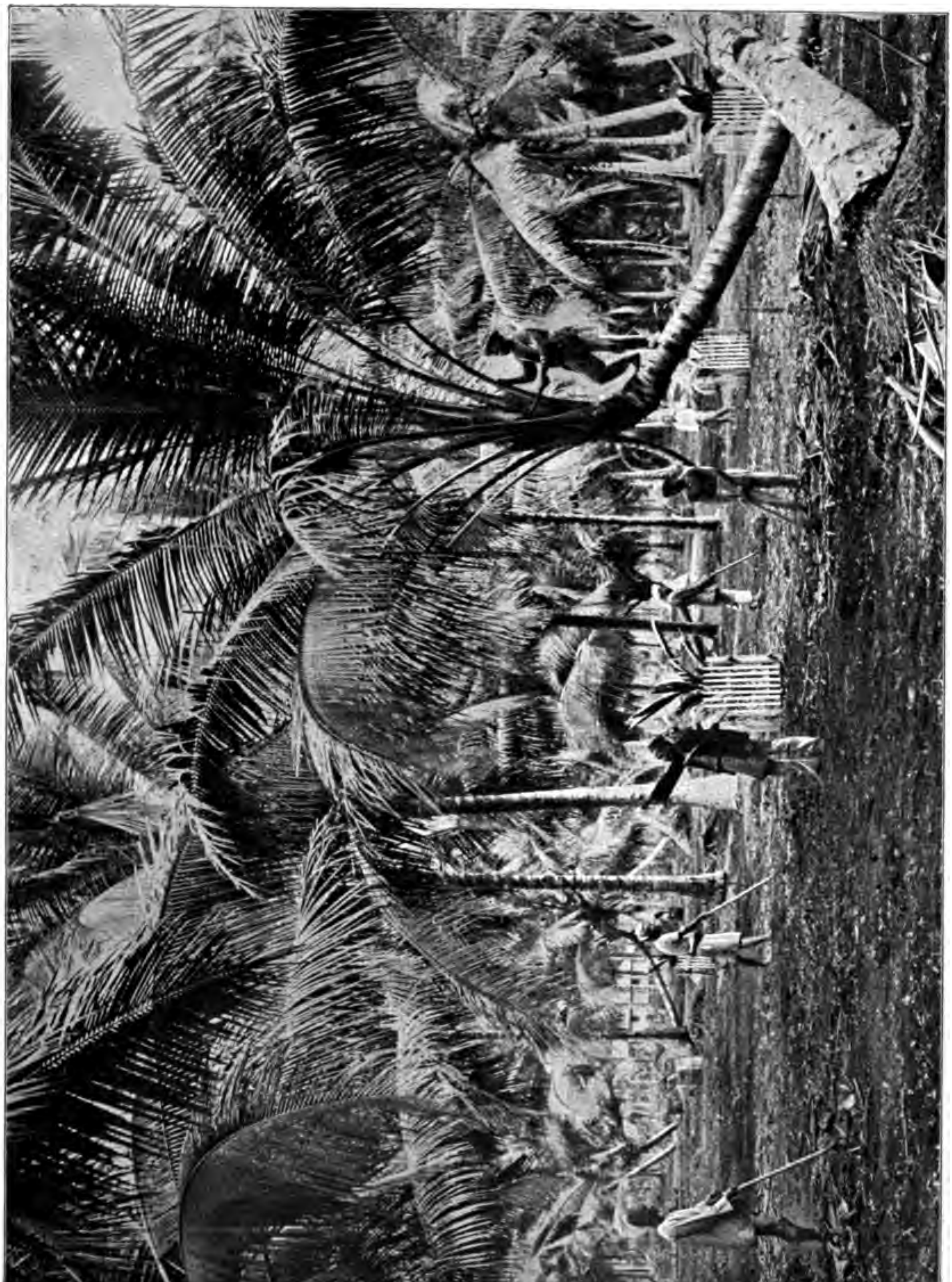
THE FLORIDA TRUCK GARDENS.

At Miami the truck gardeners are raising immense quantities of tomatoes and other vegetables. Corn in the ear and peas, beans, and tomatoes may be found ready for market in the beginning of April. A small limb on a grape-fruit tree often contains as much as 50 pounds of fruit.

SPONGE FACTORY AT KEY WEST.

Not the least interesting and important among the features of Florida production is the sponge industry, a representation of which appears in this connection.

LATEST METHOD OF GROWING PINEAPPLES IN FLORIDA.



COCOANUT PLANTATION.

Cocoanut Raising, so profitable in India, as shown by the above illustration, is also one of the industries of Southern Florida.

MAKING MONEY AT THE MINT

The United States mint was established by act of Congress April 2, 1792.

COPPER CENTS, FIRST MONEY COINED.

The first money, copper cents, was coined in 1793 in the building erected by the government on the east side of Seventh street, near Market street, Philadelphia. The first director of the mint was David Rittenhouse, LL. D., and among his successors have been Elias Boudinot, Robert Paterson, James Ross Snowden, James Pollock, Dr. Linderman and Col. Snowden.

SILVER DOLLARS AND GOLD EAGLES CAME NEXT.

Silver dollars were the second money made, in 1794, and next gold eagles, in 1795. The first machinery, as well as metal used, came from England, and up to 1816 all work was done by horse or hand power. During five years of the mint's existence, work has been suspended owing to the prevalence of disease in the city. The present mint, on Chestnut street, near Broad, built of white marble, in the Grecian style, was finished in 1833.

NO GOLD EAGLES COINED FOR 33 YEARS.

No eagles were coined from 1805 to 1837, inclusive.

PERIODS OF CESSATION IN CERTAIN COINAGES.

No half eagles were coined in 1816 or 1817; no quarter eagles before 1796, nor in 1800 or 1801, nor from 1809 to 1820, or in 1822, 1823, 1828 or 1841; no dollars from 1806 to 1838, except 1,000 in 1836; no half dollars from 1797 to 1800, nor in 1815; no quarters before 1796, none from 1798 to 1803, none from 1808 to 1814, and none in 1817-24-26-29 and 1830; no half dimes in 1798, 1799, 1804 and 1806 to 1828; no cents in 1815, a few specimens in 1823; no half cents in 1798, 1801, 1812 to 1824, 1827 to 1830, 1834, 1837 and 1840. A few half cents were struck every year from 1840 to 1857. The first $3 pieces were made in 1854.

The silver dollar coinage of 412½ grains, the 5-cent and 3-cent silver pieces and the bronze 2-cent piece ceased April 1, 1873.

SAN FRANCISCO, DENVER AND CARSON CITY MINTS.

The mints at Carson and San Francisco coin gold and silver only, and the Denver mint is confined to assaying and refining.

THE WEIGHING ROOM.

The first process of the mint is in the weighing room where all precious metal—gold from California, Georgia, Montana and Nova Scotia, and silver from Nevada and most of the world—is weighed. Here come, also, family plate and bricks of silver, copper from Lake Superior and nickel from Pennsylvania. Tons of silver bricks are here, weighing from 100 to 150 pounds each.

The largest weight used in the weighing room is 6,000 ounces; the smallest weight used in the mint is in the assaying room and weighs 1-1300 of an ounce.

THE DEPOSIT MELTING ROOM.

The metals for coining, including gold dust, grains of gold and crystalline lumps, next go to the deposit melting room, where they are placed in pots, and with a suitable flux, are melted and molded.

ASSAYING.

Bits are cut off for assaying before the metal goes to the refiner and melter. For assaying, the small bit of gold is taken to the assayer's room, a dark department, with crucibles, kettles and pans. It is put into a black lead pot, melted and fluxed, stirred up to make a complete mixture and then cooled and rolled out. Then half a gramme is weighed, which is stamped 1000, and all the weights thereafter used are decimals of this, to the ten thousandth part.

Silver for the alloying is next added, and then lead for the cupellation; the whole is cupelled until the base metals are fused, the remaining bullion is beaten in a spiral, the silver dissolved out and the remaining gold determined by weight. Iron molds are used in the melting room, which are previously greased to prevent sticking and all the gold and silver used in the mint, in molten mass, are poured into these and speedily cooled. The long, thin, rich-colored bars resulting are called ingots.

THE ROLLING ROOM.

From the melting room the bars go to the rolling room, where 200 per hour pass through the mighty revolving jaws of each pair of rollers, coming forth with the exact thickness of a coin.

In the same room with the rollers are nine cutting presses, which, with a continual snap, snap, bite out 225 planchets of plain coin pieces in a minute. These planchets are taken in boxes to the annealing furnaces, for the hard treatment they have received makes them brittle. They are heated in the furnaces to a red heat and, having become soft and pliable as leather, are taken out to cool.

THE ADJUSTING ROOM.

The planchets then go to the adjusting room, where they are weighed and inspected. If too light, they are remelted; if a little too heavy, they are filed to the right weight; but if much too heavy, they, too. are remelted.

THE CLEANING ROOM.

From the adjusting room the planchets go to the cleaning room, where with acid and heat they are thoroughly cleaned, and then dried with sawdust and peanut-roaster contrivances. They are then milled and have their edges turned up, after which they go to the presses.

THE PRESSES.

The presses are ten massive monsters, each capable of turning out over 100 coins per minute. The amount of pressure required to make a perfect coin is from 20 to 80 tons, according to the size of the coin. The planchets are put in a brass tube, and with each impress are caught in two iron arms and placed on the lower die, which is in the bed of the press, corresponding to the upper die, and by the coming together of these two dies the coins are struck. As the planchet rests on the lower die, the upper descends and impresses it, and the two arms instantly catch the coin struck and throw it into a box beneath.

NOW LEGAL COIN. THE COUNTING.

At this moment it is a legal coin. The coins are then taken from the boxes and placed on grooved counting boards, similar to washboards, which hold a certain number of coins. After this count they are poured into a drawer, out of which they are again counted, and placed in bags, ready for their mission of happiness or wretchedness.

NINE GREAT WONDERS OF AMERICA

Croton Aqueduct, in New York city.

Fairmount Park, Philadelphia, largest park in the world.

Lake Superior, the largest lake in the world.

Washington Monument, Washington, D. C., 555 feet high.

Yosemite Valley, California, 57 miles from Coulterville, which is from eight to ten miles long, and about one mile wide. It has very steep slopes, about 3,500 feet high, a perpendicular precipice 3,089 feet high, a rock, almost perpendicular, 3,270 feet high, and waterfalls from 700 to 1,000 feet high.

NEW YORK AND BROOKLYN BRIDGE—VIEW FROM SOUTH STREET, NEW YORK CITY.

Mammoth Cave, in Kentucky, the largest cave in the world.

Niagara Falls, with a sheet of water three-quarters of a mile wide and a fall of 175 feet.

New York and Brooklyn Bridge.

"Flatiron" Building, New York.

SALARIES PAID BY THE UNITED STATES GOVERNMENT

PRESIDENT, VICE PRESIDENT AND CABINET.

President, $50,000; Vice-President, $8,000; Cabinet officers, $8,000 each.

CONGRESS.

United States Senators, $5,000 and mileage.

Members of the House of Representatives, $5,000, with mileage.

SUPREME COURT.

Chief Justice, $10,500.

Associate Justices, $10,000.

U. S. CIRCUIT AND DISTRICT COURTS.

Circuit Court Justices, $6,000.

District Court Justices, $5,000.

HEADS OF MINOR DEPARTMENTS.

Superintendent Bureau of Engraving and Printing, $4,500; Public Printer, $4,500; Superintendent of Census, $6,000; Superintendent of Naval Observatory, $5,000; Superintendent of Signal Service, $4,000; Director of Geological Surveys, $6,000; Director of the Mint, $4,500; Commissioner of the General Land Office, $4,000; Commissioner of Pensions, $5,000; Commissioner of Labor, $5,000; Commissioner of Indian Affairs, $4,000; Commissioner of Education, $3,000; Commander of Marine Corps, $3,500; Superintendent of Coast and Geodetic Survey, $6,000.

TREASURY DEPARTMENT.

United States Treasurer, $6,000; Register of the Treasury, $4,000; Comptroller, $4,000.

POST-OFFICE DEPARTMENT.

Four Assistant Postmaster-Generals, each $4,000; Chief Clerk, $2,500.

POSTMASTERS.

Postmasters are divided into four classes and receive the following salaries: First class, $3,000 to $4,000 (except in New York city, where the salary is $8,000); second class, $2,000 to $3,000; third class, $1,000 to $2,000; fourth class, less than $1,000. Those in the first three classes are appointed by the President and confirmed by the Senate; those of fourth class are appointed by the Postmaster-General.

DIPLOMATIC APPOINTEES.

Ambassadors to France, Great Britain, Germany, Mexico and Russia, $17,500.

Envoys Extraordinary and Ministers Plenipotentiary to Austro-Hungary, Brazil, China, Italy, Japan and Spain, $12,000; to the Argentine Republic, Belgium, Chili, Columbia, Guatemala, Nicaragua, Peru, the Netherlands, Turkey and Venezuela, $10,000; to Denmark, Hayti, Paraguay and Uraguay, Portugal, Sweden and Norway, and Switzerland, $7,500; to Bolivia and Ecuador, $5,000, and to Greece, $6,500.

Ministers Resident to Corea and Siam at $7,500, and to Persia, $5,000.

Consuls General, four at $6,000 each; three at $5,000 each; six at $4,000 each, and eight at $2,000 to $3,500 each.

Consuls, 72 at $1,000 to $3,500 each;

ARMY OFFICERS.

General, $13,500; Lieutenant General, $11,000; Major General, $7,500; Brigadier General, $5,500; Colonel, $3,500; Lieutenant Colonel, $3,000; Major, $2,500; Captain, mounted, $2,000; Captain, not mounted, $1,800; Regimental Adjutant, $1,800; Regimental Quartermaster,

$1,800; First Lieutenant, mounted, $1,600; First Lieutenant, not mounted, $1,500; Second Lieutenant, mounted, $1,500; Second Lieutenant, not mounted, $1,400; Chaplain, $1,500.

NAVY OFFICERS.

Admiral, $13,500; Vice-Admiral, $9,000; Rear-Admirals, $6,000; Commodores, $5,000; Captains, $4,500; Commanders, $3,500; Lieutenant-Commanders, $2,800; Lieutenants, $2,400; Masters, $1,800; Ensigns, $1,200; Midshipmen, $1,000; Cadet Midshipmen, $500; Mates, $900; Medical and Pay Directors, Medical and Pay Inspectors, and Chief Engineers, $4,400; Fleet Surgeons, Fleet Paymasters and Fleet Engineers, $4,400; Commander of Marine Corps, $3,500; Surgeons and Paymasters, $2,800; Chaplains, $2,500.

THE GOVERNMENT OF GERMANY

What is commonly known as Germany is, in fact, a federation of numerous kingdoms, duchies and principalities. The country is generally thought of as representing absolutism in the person of the German Emperor. This is hardly the case.

ORGANIZATION OF THE GERMAN CONFEDERACY.

When Central Europe was ravaged by Napoleon, the numerous German states sought alliances with each other for protection against the common enemy. For a long time Austria was the leader. At the time of the war of 1866, however, Prussia came forward, and Austria was relegated to the background. When Prussia emerged victorious from the Franco-Prussian War, in 1871, the coalition of states elected William of Prussia its president and crowned him Emperor in the palace of the French king at Versailles. Shortly after this, a convention was called which framed a constitution. Three forces had been at work to bring about this empire, namely: the protection sought by the German kings and princes, the desire of the great Bismarck to make Prussia dominant, and the efforts of the small German rulers to perpetuate their rights to their individual thrones.

The individual states that entered into the confederation yielded up much of their power to the imperial government. In fact, the coalition is not loose, but is a firm pact —an "indissoluble union of indestructible states." The local laws mostly govern. In the courts of these states there is the usual system of local and superior courts in the several kingdoms. Aside from the management of their local affairs, the smaller states have reserved principally the right of representation.

THE IMPERIAL GOVERNMENT.

The imperial government consists of the Emperor and his officials, the Bundesrath, or federal council, similar to the United States senate, and the Reichstag, similar to the house of representatives. The latter is made up of about 400 members, elected by popular vote, for five years. Any citizen 25 years old can vote or be a candidate. Members receive no pay, but their transportation is paid. The federal council is made up of ambassadors from the individual states, selected by their individual rulers,

with the aid of the local legislatures. Each state casts its votes according to the number of its representatives, through one spokesman for each state.

THE IMPERIAL COUNCIL.

This body is perpetual, and must be convoked by the Emperor, at the request of one-third of its members. The Imperial Chancellor is president of this council, and his vote decides in case of a tie. The concurrence of the Bundesrath in the legislation of the Reichstag is necessary to make such legislation valid, and the former ratifies or rejects treaties and executes laws, when no other provision has been made. Thus the council seems to have the actual sovereignty of the Empire. Bills to be introduced in the Reichstag must have the support of 15 members. The Reichstag must be consulted on war, and neither house can adjourn, save from day to day, unless the Emperor names a day of adjournment. The Emperor can also dissolve the lower house and order a new election within 60 days. When a bill affecting only a certain state is brought up in either house, only the representatives of the state affected by the bill vote upon it.

THE IMPERIAL CROWN.

The constitution makes the imperial crown hereditary with the oldest male member of the royal Prussian house. Thus a man is always on the throne, and Prussia has the greatest influence. This custom allows the Emperor to arrogate to himself much power and many privileges. The German people, moreover, are much impressed with the grandeur of the imperial throne, and the Emperor is absolute lord of 5,000,000 soldiers, and represents the Em-

THE GERMAN EMPEROR.

pire in all foreign affairs. He controls 17 delegates in the council as king of Prussia, and only 14 more votes are necessary for legislation. Prussia also has an absolute veto power on questions relating to the army, navy, and imperial taxes.

Experts prepare most bills for passage, and if they pass the council they are sent to the other house. Amendments to the constitution, instead of being referred to the people, are put through the council. Fourteen votes against an amendment will check it. Thus Prussia may stop legislation harmful to her power, yet the smaller states can readily prevent encroachment.

THE IMPERIAL CHANCELLOR.

The Imperial Chancellor generally controls politics, and is the Emperor's principal adviser, being appointed and removed by him at will. He is the head of the Prussian delegation in the council, as well as president of that body. All acts, to become laws, must be signed by him. Bismarck, the prime mover in the establishment of the Empire, was the greatest of Chancellors.

LAWS OF THE EMPIRE.

The Empire's laws take precedence over those of the component states, and are executed upon an unruly state by force of arms. Contributions, pro rata, from all the kingdoms may be called for in emergencies, but the ordinary taxing powers of the Empire are limited to customs, and to revenues on beer, tobacco, salt, sugar, and a few other commodities. Coinage is controlled by the Empire, as are the railroads and telegraphs, although a few railways are owned by the kingdoms, which are also allowed to operate mints.

The judiciary of the Empire includes an imperial supreme court made up of 18 judges appointed for life by the Emperor. An appeal to this tribunal from the superior courts of the kingdoms may be had. A code of criminal laws, another for commercial affairs, and a third, civil code, that governs the judiciary of all the kingdoms, have been established by the Empire. There is no bill of rights in the constitution, to guarantee to the individual certain privileges and immunities common in many countries.

MOVING BOATS BY CABLE ON THE ELBE

On the River Elbe an odd method of moving boats is used which is not followed in any other part of the world. The stream is too swift to navigate in the usual way, and hence a chain 290 miles long is laid at its bottom. The boats are 180 feet long and are provided with 200-horse-power engines, which turn a drum fastened on the deck.

The chain comes in over the bow, passing along on rollers to the drum, around which it is wound three times. The chain is then carried to the stern, where it drops back into the water. The steamers tow five barges, containing 1,500 tons, and their only means of locomotion is by the chain wound around the drum, which is propelled by the engines on board the boats.

THF UNITED STATES GOVERNMENT FISHERIES

The United States Fish Commission and the steamship Albatross secure records of depths surrounding the Hawaiian Group and the islands of the South Seas, and regularly send consignments to the main fish station at Washington by vessels sailing round Cape Horn.

CRUISE OF THE GORGON.

Not since the British government cruiser "Gorgon" returned from its voyage in the interest of science, has any vessel been so thoroughly equipped to investigate the depths of the ocean and learn the character of its inhabitants.

THE SIGSBEE TRAWLING DEVICE.

By the use of the Sigsbee net (invented by Charles D. Sigsbee, Captain United States Navy, late of the lost battleship Maine) it is possible to gather

"TRAWLING" ON THE FLOOR OF THE PACIFIC,
Five Miles Under the Ocean Surface

specimens at the astounding depth of five miles, and the construction of this device insures the capture of anything entering it, as it cannot be opened until drawn up to the ship.

The value of this vessel's work is incalculable to ichthyologists and navigators, teaching the former new forms of submarine life, and giving the latter soundings of dangerous shoals, hitherto uncharted by hydrographers.

The Albatross touched at the Marquesas Group, the Paumotu Islands, the Society Islands, the Tonga Islands and many others.

THREE HUNDRED AND FIFTY SPECIES OF FISH.

The voyage resulted in the taking of 350 species of fish, of which 70 were new to science. Nearly all were good for food. Most of the fish caught by the natives of the islands are eaten raw.

BUYING HUMAN HAIR IN GERMANY

Every autumn the hair buyers of Germany start out from Berlin to purchase the luxuriant tresses of women and girls who live in the villages along the Spreewald. In this region the inhabitants, who are of Slavic origin, preserve the language and many of the customs of the ancient vandals. The women and girls wear their heavy masses of silky hair rolled in great coiffures on their heads, and are not averse to being shorn if the buyers offer a figure high enough.

METHODS OF THE HAIR BUYERS.

The women are fully aware that human hair is a desirable commodity, and they always set a good price for their locks. The buyers are used to the business, however, and are good at driving a bargain, so there is a great deal of haggling before the purchase is finally concluded. The buyers, when commencing operations in a village, always first endeavor to put the inhabitants in a pleasant humor. They invite the villagers to come to the inn, where the former act as hosts, and treat everybody to wine and schnapps. After a day or two spent in establishing themselves as good fellows in the opinions of the townspeople, they begin work. They pick out the girls and women who have the best heads of hair, and offer them a low price for their locks. The women at once name a very exorbitant sum and then the trade is fairly begun. The women talk and argue until finally a compromise is reached, the price is agreed upon, and the village barber trims off the long, wavy locks and turns them over to the buyers.

PRICE OF A HEAD OF HAIR.

The price of a head of good hair depends upon its quality, luster and color, and upon the age of the person on whom it is grown. The hair of girls between the ages of 12 and 17 years is deemed most valuable. A good head of hair is worth all the way from $8 to $25. The hair thus obtained is exported all over the world.

MOUNTAIN CLIMBING IN SWITZERLAND

Perhaps the most striking fact brought out in a recent report of the Swiss Alpine Club, dealing with accidents in the Alps during the ten years from 1890 to 1901, is the relatively small number of deaths caused from mountain climbing. Certainly most will learn with surprise that out of a total of 100,000 tourists who visit the Alps every year, a large proportion of whom climb the peaks, few lost their lives.

MOUNTAINEERING IN SWITZERLAND.

NATIONALITY OF THOSE KILLED.

Judged by this test, it would seem that, despite all its perils, mountaineering is a less dangerous pastime than many others—say, motoring, or cycling, for example—which are generally accounted much less hazardous. The figures given as to the nationality of those killed during a given period are also rather unexpected. The vast majority, it seems—190, to be precise—were Germans and Austrians, forty-eight were Swiss, twenty-three Italians, eighteen English or American and fifteen French. Most of the accidents occurred, too, in the eastern Alps—which helps, no doubt, to explain the preponderance of the German-speaking climbers among the victims.

It is somewhat surprising, none the less, to find that the latter outnumber so largely the English and Americans, and that these together in their turn are hardly more numerous than the French. Doubtless there is something in the explanation that British climbers, as a class, engage good guides, and in addition do their climbing as a rule at the time of the year most favorable for

mountaineering; also, perhaps, their exceptional aptitude for the sport may go for something; but still the figures are surprising. What would be interesting to learn would be the proportion of lives lost to the total number of climbers in the case of each nationality. But this information is not supplied.

CAUSES OF ACCIDENTS.

As to the causes of accidents, they are catalogued as follows: 1, neglect to employ good guides; 2, foolhardiness; 3, vanity and the spirit of emulation; 4, carelessness; 5, want of experience; 6, absentmindedness; 7, false economy on food or necessaries; 8, injudicious use of alcohol; 9, climbing at the wrong season—in the early spring or late autumn or winter. A sufficiently comprehensive list, it must be agreed. Yet even so, it is probably not exhaustive. Who can wonder at the perennial fascination of such sport?

THE GOVERNMENT OF GREAT BRITAIN

The abuses to which the thirteen original American colonies were subjected by the British crown caused the Revolutionary War, and impressed a deep-set opinion of the absolutism of the British government on the minds of many Americans.

HOUSES OF PARLIAMENT AND WESTMINSTER ABBEY.

It is a fact, however, that with all the pomp and ceremony of royalty, the government of Great Britain is one of the most liberal in the world. It is monarchical almost in name only, for although the crown of England passes to the oldest member of the reigning family, and with it the sovereignty over all the British Empire, yet its power is

limited so that the monarch cannot use coercion on subjects without great risk of revolution and dethronement.

FATE OF CERTAIN EARLY MONARCHS.

Although the government is a limited monarchy, it is almost a democracy, built upon an unwritten constitution of customs and on a parliament of two houses--the lords and the commons. These working through a cabinet and influenced somewhat by the king, carry out ultimately the will of the people. The constitution is the outgrowth of centuries of struggle between parliament and the monarchs. In early times, the rulers were practically absolute, but when some of the more cruel ones were deposed, executed or judged insane and regents were appointed in their places, the people gradually acquired rights which they guarded jealously, and never permitted to be lost. Charles I. was deposed, and for a time Oliver Cromwell, as president of the great Commonwealth, governed in democratic form. Then came the monarchy again, but as soon as James II. attempted to become an absolute monarch, he was deposed and William and Mary succeeded. Since this time, the cabinet has played an important part in the government of Great Britain. At the time that George I. came to the throne, from a German family, he did not understand English, and, naturally, the cabinet was his mainstay. George III. tried to do away with this institution, but the people's action finally brought him back to using such advisers, and since then the cabinet has become a permanent fixture, though not mentioned legally as such, being simply the outgrowth of custom.

THE CABINET.

The cabinet is a body made up of from 15 to 20 of the chief ministers of the several portfolios or departments of the government. In order that this system of cabinet government may work out most effectually, two rival parties are presupposed. Each party, criticising the acts of the other and striving for supremacy, keeps the other on its metal. The ministers of the cabinet naturally belong to the party in power. Thus they control the situation well enough to pass any measures the administration may propose. When, through waning popularity, poor government, or for any similar reason, the cabinet party lacks sufficient support to pass its measures, it resigns the cabinet positions. There is the alternative of appealing to the public in elections. If recourse is had to this method, the house of commons is first dissolved. If the members are returned by vote of their constituents, the administration is vindicated, and the bill in question is passed. In order to accomplish this, however, it becomes necessary sometimes, though very rarely, to coerce the house of lords. This is done by a threat from the king that he will create enough new peers to accomplish the desired legislation.

From the foregoing it may be seen that the house of commons directly represents the people, and that when it comes to appealing to the public at large in regard to measures that receive universal support, it surpasses the house of lords in power. In like manner it can be understood that the monarch, in order to be in perfect accord with his people, must coincide to a great degree with this branch of parliament.

As before said, the cabinet is not recog-

nized by law, but is the outgrowth of custom, its origin having been a secret body of advisers of the crown. Naturally, in the beginning, the more powerful party in parliament was sought out by the sovereign to aid him in securing legislation. The cabinet of to-day, therefore, resigns when it no longer has the support of parliament, and thereupon the king calls to his aid the leaders of the opposite party. These he appoints to the ministerial offices (the privy council) and from them he selects his cabinet. This body has no authority save in that they are members of the privy council, and the premier who, also, is not recognized by law as such, gains his authority through being a minister, generally, the minister of foreign affairs.

PARLIAMENT.

One of the strong points of the government is, that while the monarch has no veto power, yet so imbued are the people with the idea of royalty, and such is their respect for their sovereign, that they would not return members to parliament who would knowingly oppose his will. The ruler gives his advice and counsel to his cabinet, and receives their suggestions as to his ideas, and as a result, measures thus planned are sent through the houses of parliament. When the houses are unanimous, legislation is unimpeded; when disagreement occurs, the methods before mentioned for vindicating the cabinet may be used, or a new ministry may be formed. This system presupposes that the king can do no wrong, and the ministry in power is made directly responsible for bad management.

As the constitution is not a written instrument, parliament is all-powerful. Its legislation is presumed to be constitutional, and courts do not pronounce upon its acts.

THE JUDICIARY.

The judiciary holds office for life and cannot be removed except for cause. Thus, in the main, its acts tend toward justice. It is entirely separated from the legislative and executive departments of the government, although to some extent it is appointed. Should it interpret laws adverse to the wishes of parliament, that body would enact new laws which would nullify its decisions. The house of lords is a hereditary body. It has almost co-ordinate power with the house of commons, save that it cannot introduce or amend financial measures. The privy council is the official body that confers with the ruler and signs enactments. The king makes formal appointments, and the cabinet must have the support of the majority of parliament to hold office. Thus the commons, which is the most numerous body, may be said to choose the cabinet. When a new parliament is chosen, the public, practically, chooses the new prime minister, for it has the leaders of the opposing party in mind when casting votes. All acts must be performed in the light of publicity, to gain favor, because there are two parties.

Lastly, the English system necessitates the development of the individual leader, who can dominate his party, and thus make cabinet rule possible over sovereign and lords.

IN A KING'S KITCHEN AND PLATE ROOMS

The Royal kitchen of King Edward VII. is a room of considerable size, much larger in fact than the kitchens of many of the leading London restaurants, and scores of meals are prepared there every day.

ITS COSTLY FINISH.

It is fitted up throughout with black oak, for which George III. was responsible, he having expended $50,000 in this direction alone. Besides the kitchen proper, there are the confectionery room, the pastry room and the bakehouse.

THE CLERK AND THE CHEF.

The clerk of the kitchen, who rejoices in a salary of $3,500 a year, is responsible for the conduct of these departments, and he has to deal with all the tradesmen who supply the royal household. But the potentate of the kitchen is the chef, who also receives $3,500 a year, and under him are four master cooks, each of whom has control of a small army of assistants, while the confectionery department is ruled by two yeomen with salaries of $1,500 and $1,250.

ECONOMICAL MANAGEMENT.

Such a thing as unpunctuality is unknown in the king's kitchen. The most rigid economy is practiced, and such food as remains unconsumed is distributed among the poor, who apply at the castle gate every day.

NINE MILLION DOLLARS IN PLATE.

The king's kitchen hides something like $10,000 in copper and iron utensils and $9,000,000 in plate. Among the former should be mentioned the enormous meat screen of solid oak lined with metal, which is nearly 300 years old, and bears the imperial badge of the house of Tudor—the portcullis and arms. Connoisseurs have sighed in vain for this meat screen, for its worth is inestimable.

FOUR THOUSAND KITCHEN KNIVES, 3,000 KITCHEN FORKS, AND 800 POTS AND PANS.

Then, there are 4,000 knives, 3,000 forks and as many spoons, used for cooking and kitchen purposes.

EIGHT THOUSAND FORKS AND SPOONS OF MASSIVE SILVER.

There are also 8,000 forks and spoons of massive silver for use at the royal table. There are 800 pots and pans, mostly of copper, and five scourers are solely employed to keep them brightly burnished.

PLATE EQUAL IN VALUE TO 18 TONS OF SOVEREIGNS.

Not far away are the plate rooms, two in number, which, although they measure only 13 by 16 feet, hold treasures eighteen tons of sovereigns would not buy.

SOLID GOLD SET OF GEORGE IV.

The most valuable item in the storeroom is, of course, the famous service consisting of plates, dishes, tureens, epergnes and candelabra, all of solid gold, which were made by Roundelle & Bridge for George IV. This service is only used on state occasions. Equally famous is the emperor's service of silver gilt, the worth of which may be vaguely gleaned from the fact that each plate weighs a stone, and the epergnes two hundredweight apiece.

GOLD DISH OF ALEXANDER THE GREAT.

There is one gold dish of surpassing loveliness which is supposed to have been used

by Alexander the Great before the battle of Hydaspes, and for upward of six centuries it has reposed at Windsor. Another much-valued piece of plate is the silver gilt flagon three feet in height, which was recovered from an Armada wreck three centuries ago, while there is a table of solid silver, the surface of which measures nine feet square and is engraved with the fou emblems of Great Britain.

A FAMOUS ENGLISH LOCOMOTIVE

The railways of Great Britain are widely reputed for substantial construction and skillful operation. So slight are the gradients and curves and so perfect is the mechanism of their equipment as to insure a combination of maximum speed and long endurance of engines. An illustration of this is found in the record of "the Charles Dickens," which is in many respects a notable locomotive. It is the record engine of England, and, incidentally, an example of what British locomotives can do.

A FAMOUS LOCOMOTIVE, THE "CHARLES DICKENS."

TWO MILLION MILES RUN.

This machine has just completed its second 1,000,000 miles. The ordinary lot of a railway engine is to run about 20,000 miles a year, so the record in this instance is practically equal to 100 years' service.

TWENTY-ONE YEARS ON THE ROAD.

But the "Charles Dickens" is only twenty-one years of age, having been turned out at Crewe in February, 1882. Its work has been to take an early train, starting at 8:30 in the morning, from Manchester to London, a distance of about 200 miles, returning from London the same day at 4 in the afternoon.

ROUND TRIPS NUMBER 5,312.

It recently completed its five thousand three hundred and twelfth round trip in addition to nearly 200 other trips that it has made, and it is significant that during the whole of its long journeyings, not a single passenger on the trains which it has hauled has suffered injury.

SPEED 50½ MILES AN HOUR.

In the twenty-one years of its service the speed has gradually risen from forty-two to fifty and one-half miles an hour, and this in spite of the fact that the weight of the trains has been increased by an addition of heavy dining and corridor cars, and other weight-involving luxuries of modern travel.

CONSUMPTION OF COAL, 27,486 TONS—OF WATER, 204,771 TONS.

During its twenty-one years of service the engine has burned 27,486 tons of coal and

has evaporated 204,771 tons of water, the consumption of coal averaging thirty-two pounds to the mile—a remarkably economical performance. The engine has been laid up for repairs during this period only 12 per cent of the time, and the cost of its maintenance has been a fraction over 1 penny per mile.

WHAT FOGS COST LONDON

The words "Thicker than a London fog" have become proverbial, and were frequently used by persons who wish to describe a dark, gloomy and, perhaps, rainy (as well as foggy) day in the United States. In this line, it would be interesting to learn what the fogs cost London.

TEN TONS OF SMOKE DAILY.

Every winter day each house in London throws into the atmosphere an average of ten tons of smoke-laden air, a total quantity of 5,000,000 tons of smoke-laden air for the inhabited houses of London per day, or, possibly, 7,000,000 tons per day, if we include factories.

London loses one-sixth of its sunshine and daylight on account of this smoke. In winter the loss amounts to one-half. The cost of clearing the air of London, either by electrically driven fans or other scientific methods, would probably be $30,000 a day, equivalent to a rate of 10d in the pound. The cost of caring for London's sewerage is about £600 per day.

FOGS COST £3,000,000 A YEAR.

On the other hand, a bad fog in London costs £5,000 a day, for additional gas alone. The yearly fogs cost, therefore, £3,000,000 to £5,000,000. A ten-penny rate would therefore be a very cheap and agreeable substitute for the smoke of London. The science of the twentieth century will give as satisfactory a solution to the question of smokes as that of the nineteenth century in the matter of sewage.

MATRIMONY IN ENGLAND

In England, a man's wife is in reality his partner, and whether or not the two are in harmony with each other in affection, they recognize in all material things that their fortunes are irrevocably bound together; that the interests of both are quite identical, and that each has just as strong a motive for making things go well as has the other, since they share equally the labor and the reward of labor.

WHAT THE WIFE KNOWS AND DOES.

They may have their private disagreements, but they confront the world together. The wife takes the keenest interest in the most minute details of everything that affects her husband's welfare. She knows his income to a penny. She manages her household as a chancellor of the exchequer manages the nation's outlay, so that the annual budget shall not only avoid a deficit,

and shall accurately balance, but shall show a surplus. She will practice rigid economy, if necessary, and in doing so, she will feel that she is merely carrying out her share of the marriage contract.

HUSBAND AND WIFE WORK TOGETHER.

It is the man's part to make money; it is her part to help him save it. She plans nothing for herself apart from him; she cannot think of him as anything apart from her. If he is in political life, she enters into his ambitions with intelligence and zeal. She will write his letters for him and entertain his constituents; she will study the blue books and teach herself to understand the public questions with which he has to deal, so that she may discuss them with him and follow his career intelligently.

A BOND OF COMMON INTEREST.

She belongs to him, in fact, as he belongs to her. There is not much display of sentiment in an English household after the first year of married life has ended; but there is the bond of a common interest, which grows stronger every day and every year, and which gives to man and wife a unity of purpose and of feeling that will, beyond comparison, outlast the ties of mere emotionalism.

SCOTLAND'S MODEL TOWN

On the banks of the winding Forth, a few miles from Falkirk, may be seen what is known as "The Model Village of Scotland." The name of this interesting little place is Dunmore. It was built long ago by the Earl of Dunmore for estate workers. It is now inhabited not only by this class, but also by salmon fishers and others, about fifty families, in all, going to make up the population. It has a village school, "a Smiddy" and a grocery shop.

In the center of the village is a lovely open space in which is the proverbial village pump. The houses are built after old architectural designs, and are comprised of rooms and kitchens. At one end of the village is the open country, while at the other are seen the waters of the Firth of Forth. It is built off the main road, and is approached by a beautifully kept carriage-way, constructed in a semicircular fashion, thus enabling visitors to drive around the village. Dunmore is in the unique position of having no public house.

HISTORICAL FACTS.

In the bog of Blair Drummond, near the Firth of Forth, a whale was unearthed in early times, which had been harpooned by means of an instrument made of the antlers of a stag. In the neighborhood of Falkirk, near the western extremity of the Firth of Forth, the sea formerly extended up the river Carron, far beyond the present head of the tide. The great Roman wall, named after Antonius, though begun by Agricola, extended from sea to sea, and the remains of it may still be seen near Dunglass, rising 25 feet above the present level of the sea. In the east it terminates on the top of a cliff at Carriden, near Falkirk.

CANADA AND ITS GOVERNMENT

The territory comprising Canada was originally discovered by Sebastian Cabot in 1497, but its history dates only from 1534, when the French took possession.

THE DOMINION OF CANADA.

The Dominion of Canada includes the various provinces of North America formerly known as Upper and Lower Canada (now Ontario and Quebec respectively), New Brunswick, Nova Scotia, Prince Edward Island, British Columbia, and the extensive regions long under the quasi-government of the Hudson Bay Company, now styled Manitoba, the Northwest Territories, the Yukon Territories, and Ungava (a strip of coast from Ungava Bay to the Straits of Bell Isle); in fact, the whole of British North America except Newfoundland and Labrador.

ITS EXTENT AND POPULATION.

This territory, nearly as large as Europe, stretches from the Atlantic to the Pacific Ocean, and is estimated to contain a total area of 3,653,946 square miles, and a population of 5,371,315 souls, which, notwithstanding its diversity of origin, is fast being welded into one harmonious and homogeneous whole.

The first settlement, Quebec, was founded by the French in 1608. In 1759, Quebec succumbed to the British forces under General Wolfe, and in 1763, the whole territory of Canada became a possession of Great Britain by the treaty of Paris, of that year.

Nova Scotia was ceded in 1713, by the treaty of Utrecht, the provinces of New Brunswick and Prince Edward Island being subsequently formed out of it. British Columbia, previously a part of the Hudson Bay Territory, was formed into a Crown colony in 1858, and was united to Vancouver Island in 1866.

The Dominion of Canada was created in 1867, by the British North America Act, which provided for the admission at any subsequent period, of the other provinces and territories of British North America.

MANITOBA.

In 1870, the Province of Manitoba was formed, and with the remainder of the Hudson Bay Territory, now called the Northwest Territories, was admitted into the Dominion. British Columbia followed in 1871, and Prince Edward Island in 1873, Newfoundland alone remaining a separate colony.

The descendants of the French colonists reside chiefly in the Province of Quebec, and the majority of them still very generally use the French language.

RELIGIOUS CREEDS.

A religious census of Canada was taken in 1901, showing the number of Roman Catholics to be 2,229,600; Methodists, 916,886; Church of England, 680,620; Baptists, 316,477; Congregationalists, 28,293; Presbyterians, 842,442; and Lutherans, 92,524.

THE CANADIAN GOVERNMENT.

The executive government and authority are invested in the King, and exercised in his name by the Governor General, aided by a Privy Council. The legislative power is a Parliament, consisting of an Upper

House, styled the Senate, and a House of Commons.

THE SENATE.

The Senate consists at present of 81 members, distributed between the various provinces, thus: for Ontario, 24; for Quebec, 10; for Nova Scotia, 10; for New Brunswick, 4; for Prince Edward Island, 3; for British Columbia, 4; for Manitoba, 4; and for the Northwest Territories, 2.

The members of the Senate are appointed for life by the Crown, on the nomination of the ministry for the time being. Each nominee must be 30 years old, a resident in the province for which he is appointed, a natural-born or naturalized subject of the King, and the owner of property amounting to $4,000.

THE HOUSE OF COMMONS.

This body is also composed of natural-born or naturalized subjects of the King. No property qualification is required, and its members are elected upon a very wide suffrage. For electoral purposes, each province is divided into districts, each of which returns a member on a vote taken by ballot. The members of the House elect their Speaker, and twenty, including the Speaker, form a quorum.

PROVINCIAL GOVERNMENTS.

Each province has also a separate legislature and administration, with a Lieutenant Governor, appointed by the Governor General.

THE JUDICIARY.

Justice in Canada is administered, as in England, by judges, police magistrates and justices of the peace, of whom the first named are appointed for life by the Governor General, from among the foremost men at the bar of the several provinces.

THE SUPREME AND EXCHEQUER COURTS.

The Supreme Court of Canada is composed of a chief justice and five puisne judges, and holds three sessions in the year, at Ottawa. The only other Dominion Court, namely—the Exchequer Court of Canada—is presided over by a separate judge, and its sittings may be held anywhere in Canada.

THE PROVINCIAL COURTS.

The provincial courts include the Court of Chancery, Court of King's Bench, Court of Error and Appeals, Superior Courts, County Courts, General Sessions and Division Courts.

The present Governor General of Canada is the Right Honorable, the Earl of Minto, appointed in 1898, for five years, at a salary of £10,000 per year.

Other interesting matter pertaining to Canada may be found under specific headings in this volume.

CANADA'S LONG BRIDGE SPAN

The bridge recently completed across the St. Lawrence river, six and a half miles south of Quebec, has the longest span in the world.

THE GREAT ST. LAWRENCE.

The great St. Lawrence flows between high, rocky cliffs at that point, and varies according to the tide. The water is about 180 feet deep in the channel, and flows by at a swift rate. The channel is crossed with a suspended span and two cantilever arms, making the unsupported structure 1,800 feet long, which by far is the longest span in the world. It is 200 feet longer than the span of the new East River bridge, New York. The length of anchor arms on each side of the main spans is 500 feet, with one approach span of 220 feet at each end, between anchor piers and terminal abutments.

The length of the structure, including abutments, is 3,300 feet. The substructure consists of two main piers, two anchor piers and two abutments. One of these anchor piers is founded on solid rock, and the other on hard blue clay. The sinking of the main caisson was a great engineering feat. At low tide the water is only ten feet deep around the two main piers.

SINKING OF THE CAISSON.

The caisson was sunk through a compact mass of granite bowlders, bound together with cobble stone and fine gravel. The penetration of the caisson was so slow that on some days the distance could not be recorded; on other days it was scarcely more than four inches, although it bore a load on its roof of more than 20,000 tons.

Owing to the immensity of this load, and its attendant danger, this method was finally abandoned, and concreting in the working chamber was begun. Progress by this method was rapid, and in 17 days the pier was built. The caissons for the two main piers are each 150 feet long, 49 feet wide and 25 feet high. They are of southern pine. The caisson for the north pier was built on the north shore, about 4,000 feet east of the pier site; it was successfully launched, towed into position, and made fast in a berth previously prepared, in the short space of 70 minutes.

SHOOTING LACHINE RAPIDS, ST. LAWRENCE RIVER.

THE GOVERNMENT OF FRANCE

France, in its government, has been a mass of anomalies. From the extreme of monarchy to the extreme of theoretical republicanism, this country has swung back and forth repeatedly. Naturally, therefore, the results of these mutations are to be found in its present government. When the aristocracy of France was put under the guillotine and the monarchy was snuffed out with Louis XVI., the masses, afraid to trust single persons, caused boards of management to be appointed. When Napoleon came upon the scene, he dominated through numbers of trusty tools. Then came changes to republic and empire, with the constant and considerable power of a great army always a factor in either kind of government. No study of the government of France is complete that does not take into consideration the great confidence placed in the army and the enormous power wielded by it. To-day, under the third republic, there is a constant struggle for supremacy between the monarchical and the republican idea of government. While France may be considered most advanced in theoretical republicanism, yet the long sway of aristocratic ideas militates against placid democracy.

COLUMN OF JULY.
Commemorating the fall of the Bastile and the rise of the Republic of France.

THE NATIONAL ASSEMBLY.

The immediate forerunner of the present form of government was a national assembly, elected to treat with Germany in 1871, after France had been humiliated in the Franco-Prussian War. This assembly found itself in control of the situation, and, while its members were largely monarchical in their views, seeing the tendency of the people toward republicanism, they framed a meager constitution and put it into effect without reference to the people.

METHODS OF ELECTION.

France has three branches of government —legislative, executive and judicial—yet they are so strongly centralized that they may not be compared with similar branches in other republican forms of government. For elective and administrative purposes, France is divided into 86 departments which are divided into 362 smaller districts, which are, in turn, divided into 2,899 cantons, and these are subdivided into still smaller divisions called communes, of which there are 36,170.

A chamber of deputies, made up of 584 members elected for four years, and a senate whose members are elected for nine years, one-third retiring every three years, make up the legislative department.

ELIGIBILITY TO OFFICE.

Every male citizen 21 years old, who is not disqualified and who has lived six months in a commune, may vote. Deputies must be 25 years old; they receive $1,800 a year and have free transportation on all railroads. These men, generally, are retired merchants, doctors or farmers, and are of only ordinary attainments. Senators, to be eligible for that office, must be 43 years old; they receive the same salary as the deputies. Ordinarily, their age is over 60 years. Deputies are elected directly from their districts, though some of these districts are large enough to elect two or more. The elections are held on Sunday. In case no candidate has a majority of votes in an election, nor receives one-fourth the number of registered votes in his constituency, another election is called for two weeks later. Then a plurality elects, and in case of a tie, the oldest of the candidates is chosen. Senators are chosen by electoral colleges and come from the departments. These colleges are composed of members of the council general of the department and of the different councils of the districts of the department, senators and deputies of the department, and electors chosen from the municipal councils of the numerous communes of the department; retired professional men of the country towns are generally elected. The duties of the senate extend principally to advising with the President as to when the chamber of deputies shall be dissolved, and in sitting in his high court in case of impeachment for grave offenses against the state. In most instances, the senate is the inferior body of the legislature.

THE PRESIDENT AND HIS CABINET.

The executive department is headed by the President who may never be a member of the royal family, and who is elected by the chamber and senate sitting in joint session. His salary is $125,000 a year; he has a great retinue of servants, and has free use of the great "palais d'elysees" of Paris. He does not have the veto power on legislation, yet he may return bills for a second vote. He may adjourn the houses for one month, may close a session that has lasted over five months, and by the consent of the senate may dissolve the chamber of deputies. The cabinet of the President is made up of the heads of 11 departments, such as war, finance, marine, etc., who receive a salary of $12,000 a year. These advisers of the President are chosen generally upon the recommendation of the presidents of the two houses. They are members of the two houses and wield considerable influence. The members of the cabinet frame legislation, sanction the acts

of the President, in order to make them valid, and speak in both houses, whether they are members of both or not. When they cannot control legislation, they resign and a new cabinet is chosen. Although the President is elected for seven years, and the life of the average cabinet is less than a year, yet the government is rather by the cabinet than by the President, who has little real power and is largely a luxurious figurehead.

THE SENATE AND CHAMBER OF DEPUTIES. MODE OF LEGISLATION.

When each annual session is begun in the chamber of deputies legislation is started by the choice, by lot, of eleven bureaus, while the senate selects nine in the same manner. A committee for parliamentary initiative is chosen from these bureaus to serve one month, to which are referred all measures when presented. This committee decides whether they are worthy of consideration. It considers a bill, has it printed and presents it to a subcommittee of the respective bureaus for further consideration along party lines. When the bill has been thrashed out to suit the views of the committee, it is presented before the house by a commissioner who reads it from a little gallery called a tribune, which is located just above and behind the desk of the president of the house. The speaker of the house, unlike the corresponding officer in the United States house of representatives, has little power. Parliamentary usages in France are very crude and members and even the president of a house will resort to trivialities, epithets and even violence in open session.

THE COUNCIL OF STATE.

The council of state, a relic of the days of Napoleon, is another body. It is made up of professional men who simply give their opinions on profound subjects for legislation, but it is rarely followed.

FAVORITISM AND SUBSIDY.

Favoritism and subsidy go hand in hand in the administration of affairs. Power in France is the main thing sought after by members of the government. The cabinet, in order to retain the good will of the chamber of deputies, upon whose whim it must stand or fall, deals out many favors in the way of offices, etc., to the minor members. The good will of the public also must be maintained in order to hold seats in the houses, and great sums of money, placed in the hands of the government for secret-service work, are frequently spent in bribing influential newspapers to support the officials of the administration.

THE JUDICIARY.

The judiciary of France differs widely from that of other countries. In her courts a man often is considered guilty until proved innocent. There is no grand jury, one judge sitting in private and deciding whether cases shall or shall not be brought to trial. The system of courts starts with the usual local justices of the peace, and ascends through courts of appeals to the final supreme court. The President, with the aid of the minister of justice, appoints the judges who, except the local justices, hold office during life. There is a special court made up of men of expert training to decide disputes within the administration, or between citizens and officers. Many courts, whose jurisdiction covers cases where sentences of but three or four years imprisonment may be imposed, are made up of three judges, who sit without juries. Higher courts have the adjunct of twelve

jurors, who decide cases by a majority vote. Commercial cases are tried before special courts, made up of experts.

CENTRALIZATION OF POWER.

To show how centralized the whole government of France is, it may be stated that even in local government the prefect or governor of each department is appointed by the President and is answerable to the cabinet. This officer is assisted by a general council elected for six years, and consists of one representative from each Canton. These govern schools, railroads, local courts and asylums. In like manner, the District or arrondissement, the next smaller division, has a subprefect appointed by the prefect of the Department, responsible to him, and really acting as his agent. The work of dividing the taxes among the Communes is done by a council, which is made up of a member elected from each of the Cantons.

THE CANTON AND THE COMMUNE.

The Canton is simply a small division for election and judicial purposes, and is a muster center of the army. The smallest division of the governmental system, the Commune, is really the unit of French government, as it is the most democratic of all. It elects its municipal council according to its population, and this council elects its mayor. But after the mayor is once elected, he immediately becomes the agent of the central government at Paris, and can be removed at will. Thus we see the possibility of the great central power exercising despotic will for a considerable period. Finally, however, elections occur, and other officials are put in who may reverse for a time the trend of affairs. While there is much knavery in French politics, the central government shows great enterprise in the matter of magnificent roads, bridges, public buildings, expositions and educational institutions.

From the American Review of Reviews.

A SCENE AT A STATION OF THE PARIS UNDERGROUND RAILWAY.

THE GOVERNMENT OF RUSSIA

Extremes meet in Russia. In this government we find absolutism or autocracy—government forced upon a people rather than made by them, and yet, in the simple home life of the Russian peasant is democracy of the purest and most tenacious type. The government of the Czar is imposed upon over 130,000,000 people, in a land that occupies one-seventh of the area of the globe, and includes the cold of two continents—Europe and Asia.

NICHOLAS II., CZAR OF RUSSIA.

THE MIR.

The "Mir" is the fundamental, or basic, principle of Russian life. This village life allows some freedom in the ownership of land. The greater portion of the people of this great country, which probably will one day dominate civilization, is of Slav origin. This race, in times when Europe was barbaric, threatened all the southern end of it with their savage hordes. In later years, when robber chiefs arose to impress the Slavs in bondage, they moved away, or when enslaved, insisted still upon their "mir" life.

SERFDOM.

At the time when most of Europe was emerging from the scourge of the feudal system, Russian nobles were only beginning to see the richness of the prize lying before

them, of unpaid labor by the peasantry of their country. They at once seized upon it, and in the serfdom that followed, the system of autocracy was developed which imposed commands and edicts upon a simple race, which never knew self-made laws.

PETER THE GREAT.

Order was brought out of chaos by Peter the Great, who died in 1725, and the absolute monarchy which he established has remained, in its principal forms, up to the present day. Much of his work was effected through the power of the Greek orthodox church, which had been the established church of Russia for many years. Peter deposed the patriarch who ruled the church, and appointed a holy synod to do his bidding in church matters. He also confiscated the lands which the church had held. Through the church, the Czar thus wields an enormous power over the minds and souls of the people. It may readily seem that with the Czar dominating the synod, beliefs not in accord with his own would not be taught. A vast amount of ceremonial marks the church ritual, and through persecution, the common people are kept in spiritual subjection.

A ONE-MAN POWER.

Three other ministerial agents perform the will of the Czar among the people: a council of state, a senate, and a committee of ministers. There is with the three bodies no division of executive, legislative and judicial duties, as in most countries. All government centers in the executive. The three divisions noted simply are mediums for the performance of duties, with a few special functions to aid in more thoroughly carrying out the anti-democratic and autocratic ideas of the Czar. Thus there is no legislative branch of the government, but only a body which simply makes suggestions to the absolute executive, and sees that these suggestions are carried out under his will. Neither is there a judiciary department, for where there are no laws, there need be no department to interpret them. In other words, the Czar wills it, the Czar sees that his will is obeyed, and the Czar punishes infractions of his will.

THE COMMITTEE OF MINISTERS.

The committee of ministers is made up of the heads of twelve departments appointed by the Czar. They may not resign, for then, the Czar would not be implicitly obeyed. This body is simply to facilitate the direction of affairs through the departments of finance, war, foreign affairs, etc., and it is the duty of its members to explain the so-called laws and see that they are obeyed.

THE COUNCIL OF STATE.

About sixty men make up the council of state, of whom twelve are heads of the various bureaus. This council considers the annual budget or expense account. Reports of the departments are read to this body and discussed, and special commissioners appointed by the Czar look into the details of the recommendations of the ministers.

Nihilism is fostered. In order to crush out these tendencies, the government invents worse tortures, and at no time is the Czar obeyed in the true spirit.

THE SENATE.

Through the senate, the people seem to have some power in making laws. This body is composed of high dignitaries appointed by the Czar. Its members have in charge the execution of all commands of

the Czar. In intent the senate is simply servile to the ruler, although the laws that it passes sometimes have the semblance of a declaration of the national will. Ministers and governors of provinces are called before this body to report upon their actions. The senate is the last court of resort in Russia's feeble judicial system, although the council of state sometimes reviews its findings.

The Russian people are, therefore, governed under the rule of an imperious monarch. They are controlled through the following instrumentalities; the holy synod, in church matters, and in matters civil, through the twelve bureaus, the committee of ministers, the council of state and the senate. All sorts of work are done in all these bodies, the prime object of the government being to bring all rule into the sole person of the Czar.

REGULATION OF DOMESTIC AFFAIRS IN THE "MIR."

In the life of the "mir," custom has gone to the other extreme. The home life is most democratic. Town meetings are called, and matters of import to the village life are discussed freely. Decisions upon such matters are arrived at in so democratic a manner that they must be unanimous to be effective. Entire freedom is expressed by the heads of the families. The "mir," or town, is all powerful in all matters that pertain directly to its domestic life. It is no branch of the rule of the Czar, and its officers are responsible to the people. If allowed to own land, and conduct their home life as they see fit, the people complain little of heavy burdens of taxation, and this is one thing in which the Czar desires obedience.

DIRE PENALTIES.

The severest penalties are meted out to people who rebel at the commands of the Czar. Assassination is often resorted to to punish infractions of orders; flogging, exile in Siberia and many other dire methods are in vogue. Little wonder is it that with such examples before them, the people desire to rise up in rebellion.

MARRIAGES IN RUSSIA

When the parents of a young Russian decide that a certain young damsel would make him a suitable wife, they keep their own counsel, and some evening, call unexpectedly at her home and stay for supper. During the meal, they watch her narrowly. If she eats fast, she will work quickly; if she uses her plate neatly and plainly, she will be a cleanly, tidy housewife; if she talks little, she will be obedient and dutiful to her husband; if she prefers rye bread to white, she will be satisfied with her lot; if she does not gaze and stare, she may be trusted not to pry into her husband's business; and if she proceeds to clear away and wash up after the meal, she will be thrifty and careful with his money. A curious part of the marriage ceremony is that when the bride and groom enter the church, both make a dash for the platform on which stands the pulpit. The idea is that the one whose foot touches it first will outlive the other, and the children will take after that one in stature, health and beauty.

SHORT SUPPLY OF PLATINUM IN RUSSIA

AN ESSENTIAL IN ELECTRICAL WORK.

Platinum is growing very scarce. The production last year did not meet the demand, and hence a good deal of concern was manifest during the last part of 1902, as to what, if anything, would take platinum's place in the electrical world. It is beyond doubt that the supply is not increasing—if it is increasing at all—at anything like the same rate as the consumption; and if this condition is not rectified and the balance readjusted it is easy to foresee a time when enterprises which depend upon platinum will languish for want of the material which it will be impossible to secure in adequate quantities, even at famine prices.

The metal is in great request in the manufacture of electrical engineering generally as well as for numerous other purposes for which no effective substitute has been found.

Something like 95 per cent of the total amount produced in 1901 (13,800 pounds), as compared with 13,250 pounds for 1900, came from Russia, and while it is probable that scientific exploration of the whole of the Urals would lead to the discovery of other sources of supply, it is pretty clear that in the government of Perm little enough progress is being made in spite of the profitableness of the industry. Perhaps the sparseness of the distribution accounts largely for this. The metal is obtained from alluvial deposits of up to four or five zolotniks (the zolotnik is equal to 66 grains Troy) and more in 100 poods of sand (3,610 pounds).

The thickness of the beds ranges from three feet to seven feet. The grains of metal are small in size, but sometimes nuggets weighing a kilogram or more are unearthed. The platinum is often accompanied by other rare metals, such as iridium and osmium. It is sent to St. Petersburg in the crude state, and, although there are refineries in that city, very little is dealt with there, and, as the demand for the metal is almost entirely from abroad, the bulk is exported as it is received from the mines.

It is said that we must look to New South Wales for the platinum of the future, and it is there that exploration parties are now working.

PLATINUM PRODUCED IN THE UNITED STATES.

The production of platinum from domestic ores in the United States during 1902 amounted to 94 ounces, valued at $1,814, as compared with 1,408 ounces, valued at $27,526, in 1901, which was the largest quantity reported for any one year since the statistics of the production of the metal from domestic ores have been collected. In 1894 the production of platinum from domestic ores was 100 ounces of crude platinum grains. This amount mainly comes from gold placer deposits in Trinity and Shasta counties, California. Of iridium, which is closely allied to platinum, 20 ounces was obtained in 1902, and 253 ounces in 1901. The United States imported platinum in 1902 to the value of $2,088,980. The market price was about $19 per ounce.

FACTS ABOUT NEW GUINEA

THE LARGEST ISLAND ON THE GLOBE.

Notwithstanding its immense seaboard, its proximity to the Australian Continent and the peculiarly interesting character of its plants and animals, New Guinea, the largest Island on the Globe, is the least known of all countries. Although it was discovered before Australia, geographers are still unable to define its coast line with precision, while their acquaintance with its interior is immensely less. The area of New Guinea has never been traversed. Our knowledge of the natives, gained mainly through missionaries, indicates that the Papuans approximate the character of the noble savage. Except where iron has been introduced by traders they live in stone houses, building on piles on the shore, or in the water, digging out their boats from the solid trunks of trees. The great bulk of testimony goes to show that the natives are a race of industrious, well-to-do savages, fond of their wives, of whom they have but one, each, and their children, and sufficiently spirited to defend themselves, but showing no antipathy to white men when once convinced of their friendliness. Rev. W. G. Lawes, a missionary traveler, found the village of Kalo laid out in streets and squares, which were swept daily by the women and kept scrupulously clean. It is probable that New Guinea is well suited to the cultivation of sugar cane, cotton, to-

MAKING FISH NETS—NEW GUINEA.

bacco and cocoanuts. The hilly districts, which comprise a considerable portion of the area of the island, have a salubrious climate.

THE CINCHONA TREE IN PERU

Several species of the cinchona tree are indigenous to Peru, and from the bark of one of them, Cinchona Calisaya, is extracted the widely-known alkaloid called quinine.

The cinchona tree grows to a medium height and is bare of branches and foliage except at its top. The natives climb the trunk, which is very smooth, and shave off the bark with knives after the manner of the accompanying illustration.

The tree derives its name from the wife of Count Chinchon, viceroy of Peru in the 17th century, who by its use was freed from an intermittent fever, and after her return to Spain, contributed to the general propagation of this remedy.

PRODUCTION OF OPIUM IN CHINA, INDIA AND PERSIA

PROCESS OF MANUFACTURE.

While opium has done much to alleviate the pains of humanity, it has also put into a dreamy stupor many a devotee of its insidious fumes. In international affairs, however, it has had a far different effect, for it has caused the shedding of English, French and Chinese blood in battle, and the diplomats of these three countries have used all of their skill in settling questions which have been raised over it.

A PROBLEM IN THE POLITICS OF EASTERN ASIA.

For many years opium has constituted a problem in the politics of Eastern Asia, in connection with the collection of taxes. In French Indo-China, it has long been contended that this drug is the chief cause of the difficulties with the native races, and that the famous pirates on whom the French made war were simply honest merchants, whose affairs were interfered with by the opium monopoly.

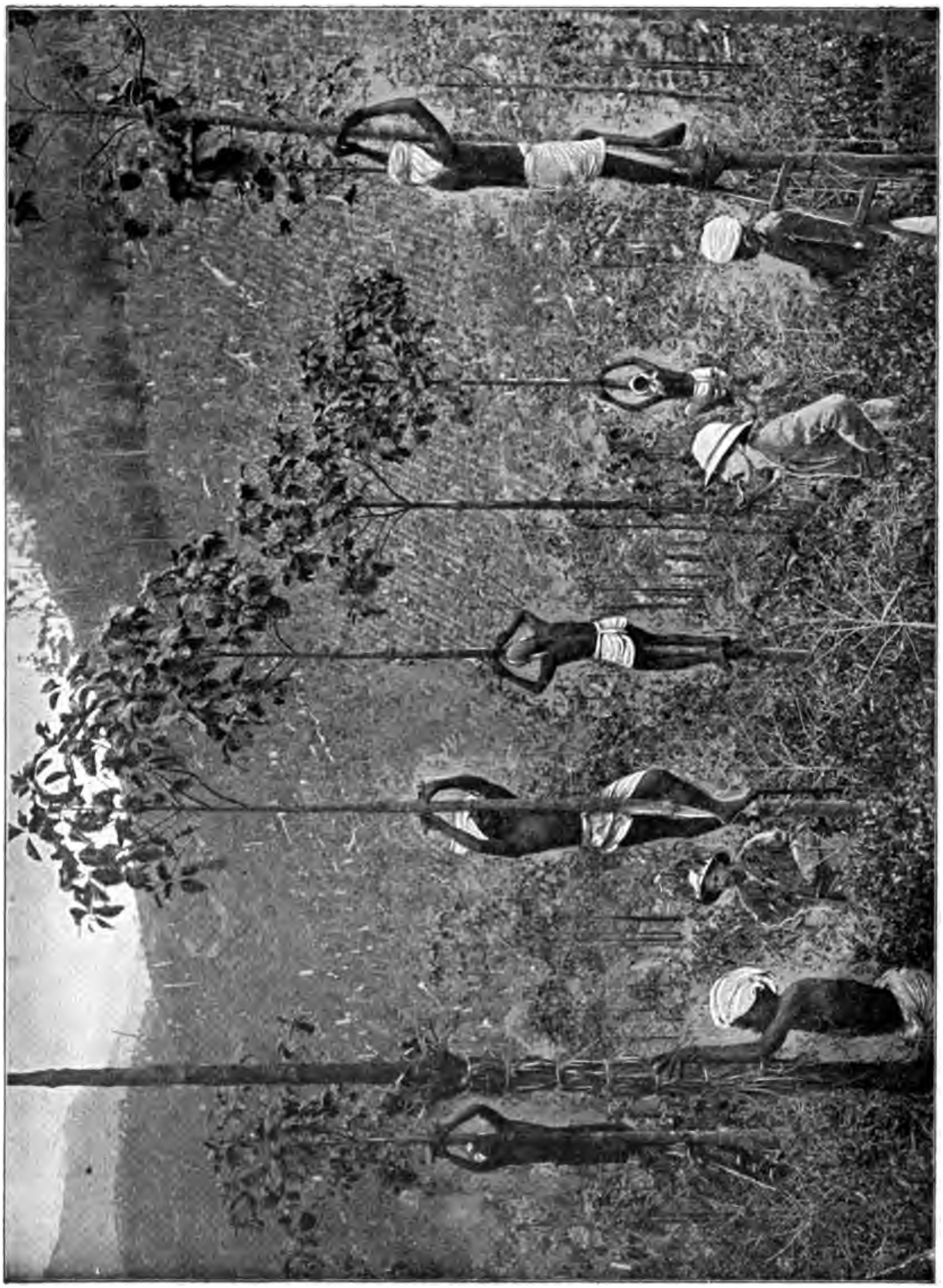
Upon Great Britain is charged the responsibility of the war between her and China, 40 years ago. It is claimed that the desire of the British to establish a monopoly of the opium trade brought on the hostilities, which ended in opium becoming the curse of the Chinese empire.

THE POPPY.

Opium comes from the poppy, many of which flowers flourish in our own gardens. Soil and climate have a great influence on the chemical qualities of the various kinds of it which are found in Persia, China, and, more especially, in India, where for many years the English government has monopolized its culture, as in France, the government monopolizes the culture of tobacco.

PRODUCTION OF THE POPPY IN THE REGION OF THE GANGES.

In all the immense and fertile valleys of the Ganges, nothing is asked of the earth



CINCHONA TREE. IN PERU.

except the poppy. Patna and Benares are distinguished by the richness and abundance of their harvests. The product of this culture in the province of Bengal, alone, is estimated at 15,400,000 pounds, which represents a value of nearly $30,000,000.

EXTRACTION OF RAW OPIUM.

Opium is extracted from the matter which exudes from the green, unripened capsule of the poppy. This matter is gathered in little globular particles, of amber color, by means of a special instrument. It is then put into small earthen pots, which are carefully covered, and then transported to the laboratories of the English government, where it is made into balls about the size of "Dutch" cheese. These are covered by petals taken from the plant. After they have been dried, they are shipped to Calcutta, the market which supplies all Asia.

THE FINISHED PRODUCT.

From this raw opium is made the finished product which is used by the smokers. The process is a most delicate one and one from which only the Chinese know how to get the best results. From Calcutta the opium is brought to the opium boiling establishments. An ordinary "boiling" place usually contains four or five large boilers, and from 150 to 175 small furnaces, each having a basin constructed of masonry, and all ranged along in the form of a long bench.

BOILING THE OPIUM BALLS.

Immediately upon the receipt of a shipment of the raw opium balls they are cut in half, the raw material being drawn out with the fingers. That part which remains attached to the envelope or covering, is afterward secured by placing it in boiling water. When these preparations have been completed, the opium is placed in the basins with the water, where it is boiled for two hours and constantly stirred until it reaches the necessary consistency, which nothing but long practice can determine. The opium worker seats himself on the ground, and with the aid of a small instrument, works and kneads the mass before him, over and over.

After a time the mass of opium is spread over the surface of the basin, which is tilted so that the direct heat of the fire is radiated against it. Under this influence, the external surface of the opium loses part of its moisture, and then becomes softer. Then the basin is taken from the fire, and the cold air operating on the surface of the mass hardens it suddenly, while the part below retains its paste-like consistency.

Then it is that the worker seizes the hardened crust and detaches it from the rest of the mass. Then, again, the basin is exposed to the fire, followed by the removal of a second, and sometimes a third, crust, which is later broken and placed in basins of water. After 24 hours, all the solid parts of the opium become separated, and the liquor is filtered and evaporated at the fire to a suitable consistency. The extract is then put into copper vessels and left to undergo fermentation, which removes from it all the acrid principles and permits it to acquire all of its necessary properties.

THE MARKET PRICE.

In its completed state, the opium presents itself in a cake, brown in color, like molasses, and exhaling an aroma difficult to describe. Then it is placed in metal

boxes of various sizes, and at last, is ready for the market. The price ranges from $20 per pound upward, according to the country to which it is to be shipped.

A CUSTOM PECULIAR TO NEW ZEALAND

Sheep are cleansed by law in New Zealand. In order to rid them of vermin, a matter which was likely to be neglected, parliament passed an act making a soaking process necessary. In accordance with this long waterways are constructed, and the animals are compelled to swim the full length of one of these courses, while men with poles push their heads under water as they pass. This immersion drowns the vermin and thoroughly renovates the wool, besides being a very wholesome and agreeable process for the sheep to undergo.

DIPPING SHEEP AT OAMARU, NEW ZEALAND.

THE WOOL INDUSTRY IN AUSTRALIA

The 28,000 square miles of volcanic country in the western portion of Victoria, Australia, with its sweet and strong Kangaroo grass, is considered the best sheep-growing region in the British colonies.

FEEDING IN DRY SEASONS.

The sheep in that section look after themselves all the year round. In very dry seasons, however, a little hay is given to the young sheep when they are teething and cannot cut the dry grass.

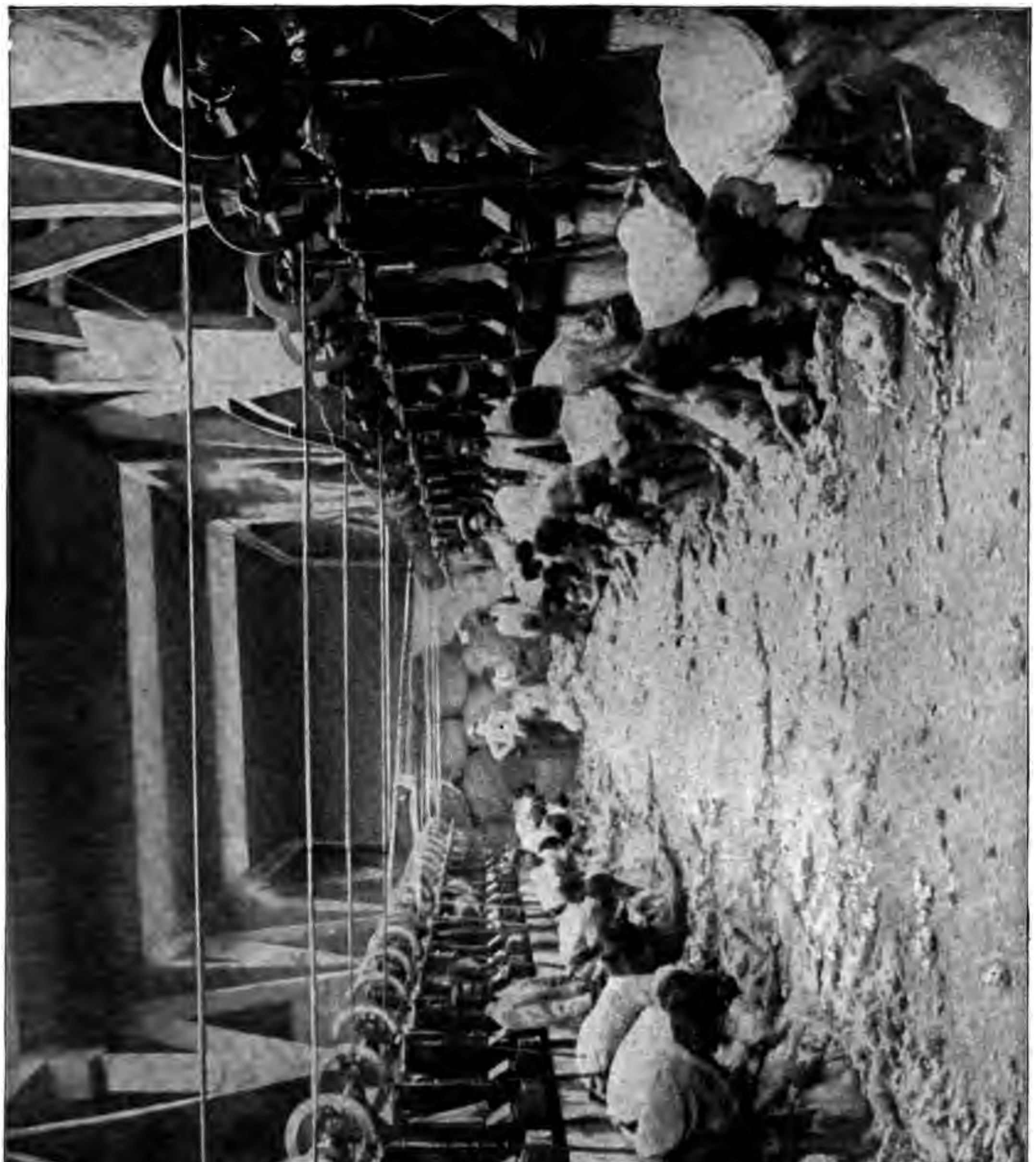
THE SHEEP STATIONS.

The Victorian sheep stations are fenced with smooth wire, except in the volcanic country, where stone walls are used. The paddocks average about 800 acres in extent, although some are large enough to support 2,000 sheep. Some of the stations include 20,000 ewes, lambs and wethers, which are kept in separate flocks.

SHEARING BY MACHINERY.

Where shearing is done by hand, one shearer is employed for each 2,000 sheep, and if an expert, he will average 80 head per day.

In 1891, however, machinery was introduced for this purpose, and in the first two years of its use, 50,000,000 sheep were thus shorn. After shearing, the fleece is sorted, combed, bound, pressed and baled,—the bales being 2 feet 6 inches, by 2 feet 6 inches, by 4 feet, and weighing about 400 pounds.



SHEARING SHEEP BY MACHINERY

THE CANNIBAL TREE OF AUSTRALIA

One of the most wonderful forest trees in the world is the "Cannibal Tree," of Australia, which grows up in the shape of a huge pineapple, and seldom attains a height of more than 11 feet. It has a series of broad, board-like leaves, growing in a fringe at the apex, which remind one of a gigantic Central American agave.

AUSTRALIAN WOOL TEAMS.

When standing erect these broad, thick leaves hide a curious looking arrangement, which appears to perform the same functions as those of the pistils in flowers. Naturally, these board-like leaves, which are from 10 to 12 feet long in the smaller specimens, and from 15 to 20 in the larger, hang to the ground, and are strong enough to bear a man's weight.

WORSHIPED AS THE "DEVIL TREE."

In aboriginal times, in the antipodean wilds, the natives worshiped the "Cannibal Tree" under the name of "devil tree," the chief part of the ceremony consisting of driving one of their number up the leaves of the tree to the apex. The instant the victim touched the so-called "pistils" of the monster, the leaves instantly flew together like a trap, squeezing the life out of the intruder. Early travelers declare that the tree held its victim until every particle of flesh disappeared. On this account it is called the "Cannibal Tree," appropriately.

THE AGAVE.

In the Central American Agave, mentioned above, the apex of which is similar to that of the Cannibal Tree, the stem is short or altogether lacking, and the leaves are formed in a close rosette, mostly stiff and somewhat fleshy, the margins usually being armed with teeth, and the apex tipped with a more or less pungent spine. It flowers in spikes or panicles. Some species flower but once and die, others occasionally, while others flower from year to year. The number of species is about 150.

LACE MAKING IN PARAGUAY

The art of lace making is well developed in Paraguay. It was taught the natives fully 200 years ago by the missionaries, and has been transmitted from generation to generation, until it is now quite general throughout the republic. Some towns are devoted to making a certain kind of lace. In one town of 8,000 or 9,000 inhabitants, almost all the women and children, and many of the men, make lace collarettes, handkerchiefs and ladies' ties. Another town makes lace embroidery, and others, drawn thread work, such as centerpieces, tray mats, tea cloths, and doilies.

DESIGNS TAKEN FROM SPIDER'S WEBS.

The designs used for making the lace are taken from the curious webs of the semi-tropical spiders that are so numerous. On this account it is called "nanduti," an Indian name which means spider web. This industry may be of service to American trade. There is scarcely a dealer in Paraguay who would not purchase American goods, if it were not so difficult to get a draft on the United States. As yet the lace-making industry is not developed in this country, the "Zion" enterprise at Waukegan, Illinois, being the first attempt.

CHINESE RICE PAPER

Among the many unique products and peculiarities of Chinese ingenuity is the so-called rice paper. It is somewhat perplexing to determine how such a name came

RICE CULTURE IN CHINA.

LAPIDARY—STONE CUTTER.

to be applied to this article, as no element of rice is supposed to enter into its manufacture.

As in most warm climates, however, rice is cultivated to an extensive degree in China, and forms a considerable portion of the subsistence of its inhabitants.

It would naturally be inferred that the Chinese rice paper would bear some relation to rice itself, but on the contrary it is said to be made by cutting the pith of a large herb (Fatsia Papyrifera, akin to ginseng) into one roll or sheet, which is flattened out under pressure. The Chinese use this paper for painting upon, and for the manufacture of fancy articles.

CHINESE MERCHANT, WITH JAPANESE AND MALAY EMPLOYES.

CANTON—EXAMINATION HALL

The Examination Hall, or Kuong Yuin, as it is called, at Canton, contains 7,500 cells measuring four feet by three, and high enough to stand up in; the furniture consists of two boards, one for sitting and the other contrived to serve both for an eating table and writing desk. The cells are arranged around a number of open courts, receiving all their light and air from the central area, and exposed to the observation of the soldiers who guard the place, and watch that no one has the least intercourse with the imprisoned students. Confinement in this cramped position where it is impossible to lie down, is exceedingly irksome and is said

to cause the death of many old students, who are unable to go through the fatigue, but who will enter the arena in hopes of at last succeeding. The characters on each side side of the cells indicate the particular place for each student.

CANTON—EXAMINATION HALL.

CHINESE WEDDINGS

A Chinese marriage is all ceremony—no talk, no levity, but much crying.

The solemnity of a funeral prevails. After the exchange of presents, the bride is

THE PRIVATE SEDAN CHAIR—CHINA.

HONGKONG.
Side View of the Peak Railway.

dressed with great care in a red gown; brocade or silk, if she can get it, her eyelashes are painted a deep black, and she wears a heavy red veil attached to a scarlet head dress, from which imitation pearls are pendent over the forehead. A feast is spread upon a table, to which the blushing bride is led by five of her best female friends.

They are then seated at the table, but no one eats. The utmost silence prevails, when finally the mother leads off in a cry, the maids follow, and the bride echoes the chorus. Then all the bridesmaids leave the table, and the disconsolate mother takes a seat beside the chair of state, where the bride sits. The bridegroom now enters, with four of his best men. The men pick up the throne on which the bride sits, and, preceded by the bridegroom, form in procession and walk around the room, or into an adjoining parlor, signifying that the bridegroom is carrying her away to his own home. The guests then throw rice at the happy couple, a custom which we have borrowed from the heathen.

ELEPHANTS USED FOR PLOWING IN INDIA

The use of a sledge hammer to drive a tack would appear scarcely more incongruous than the occasional practice of the Hindoo husbandman of having an elephant draw his plow. The employment of this powerful and sagacious animal in important work where heavy lifting is required, does not seem to detract from his dignity; but plowing appears a petty task for so noble a beast. That he does his duty, here as elsewhere, when well trained, need not be asserted. Neither stump nor stone in the way of the plowshare could stop him, although the implement itself might give way.

ELEPHANT HUNTING OR KRAALLING IN CEYLON.

The two tame ones are helping to capture the wild one between them. If he attempts to escape, they throw their trunks around him and hold him fast.

THE INDIAN PLOW.

The plow, as it is in India, is a peculiar device, with a single handle and a very long beam. The farmers of the United States would utterly scorn it. The area which

can be turned up in a day with an elephant is large, and the animal is remarkably handy in one respect. At the close of the day's labor, he picks up the plow and carries it home in his mouth. In many ways the huge beast proves useful to his owner.

DOMESTIC ELEPHANTS.

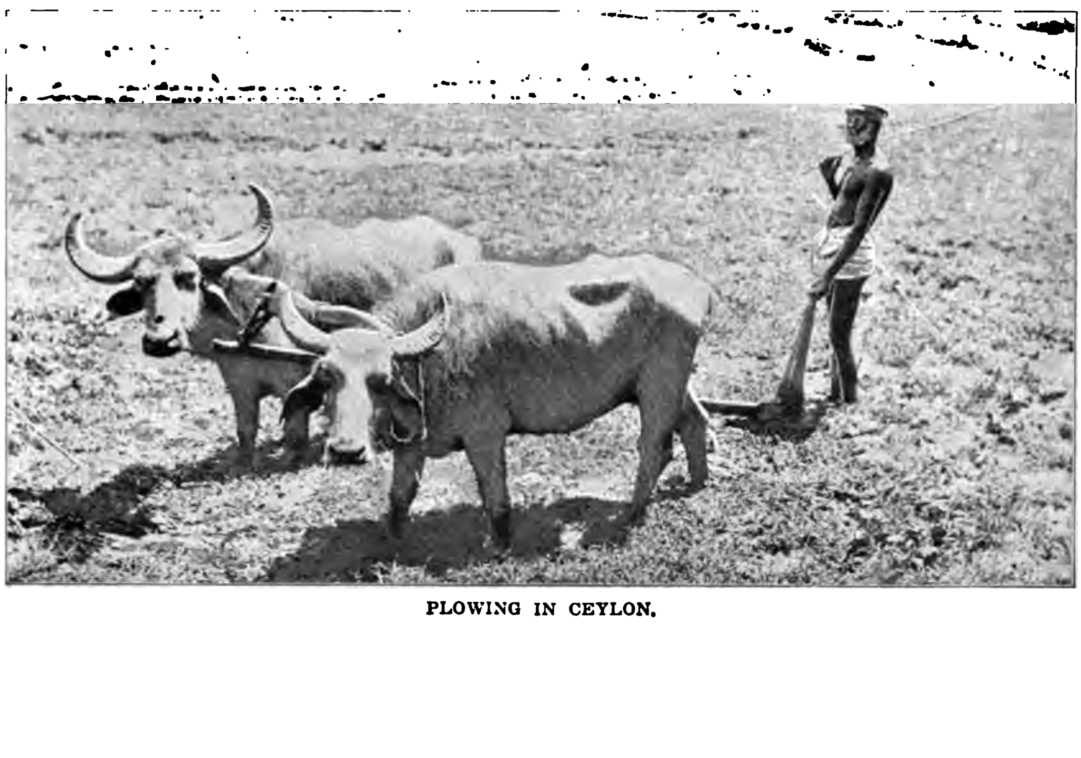
WHERE CERTAIN THINGS CAME FROM

Madder came from the East. Celery originated in Germany. The onion originated in Egypt. Tobacco is a native of Virginia. The nettle is a native of Europe.

OYSTER CATCHING, CEYLON.

The citron is a native of Greece. The pine is a native of America. The poppy came from North Africa; rye, from Siberia; barley, from the mountains of Himalaya; wheat, from Tartary; parsley, from Sardinia; the sunflower, from Peru, as, also, the potato; the parsnip, from Arabia; the cabbage, from England, although it grows wild in Siberia; millet came from India; the apple and pear, from Europe; spinach, from Arabia; the mulberry tree, from Persia; the horse chestnut, from Thibet; the cucumber, from the East Indies; the quince, from the Island of Crete; the radish, from China and Japan; peas, from Egypt; garden cress, from Egypt and the East; horse radish, from the south of Europe; the Zealand flax shows its origin by its name. The coriander grows wild near the Mediterranean. The Jerusalem artichoke is a Brazilian production. Hemp came from Persia and the East Indies. The tomato came from South America, but was known in England as early as 1587. Do-

COCOANUT TREE CLIMBER, CEYLON.



PLOWING IN CEYLON.

EXTRACTING COCOA O L—PROCESS OF MANUFACTURE.
Copsa—the inner Kernel of the Cocoanut—is ground for Cocoa Oil.

doens, a Holland agriculturist, mentions the tomato in 1853, as "a vegetable to be eaten with pepper, salt and oil." The bean came from Persia; the beet from Africa and Asia; cayenne pepper, from the West Indies; and the sweet potato, from tropical America, whence it was early introduced into Europe.

BUDDHA'S TOOTH IN BUDDHA TEMPLE.
This is most sacred; Buddhists come from all over the world to see it.

CINNAMON TREE, CEYLON.

THE DELHI DURBAR OF 1903

The Coronation Durbar at Delhi, India, in January, 1903, was in some ways the most imposing ceremonial of this generation. The Viceroy made his state entry into Delhi on Monday, and the grand Durbar on Thursday, in honor of the accession of Edward VII., formed the climax of the gorgeous pageant.

Down the Chandni Chowk, the "Silver Road," which is the grandest of Indian streets, streamed a procession in which were included all the white rulers of India, and nearly every Indian Prince of sovereign rank, Holkar and the Gaikwar being the only two important exceptions.

All rode, as beseemed a grand Asiatic celebration, upon elephants, and every elephant carried a gold or silver howdah, often flashing with gems, and was clothed in cloth of gold or silver, which under that sky shone as in Europe even gold and silver cannot be persuaded to shine.

The Englishmen were, of course, in the fullest uniform, and the princes, with the single exception of the Nizam, who was dressed in plain black, displayed those wonderful robes so seldom seen even in the East,—robes blazing with gold and gems, and embroideries almost more costly still. Everything was on a scale which impresses the Asiatic mind—elephants in endless lines, soldiers in armies, retinues in tens of thousands and myriads of delighted people, all assembled to hail in Asiatic fashion the accession of their British lord.

There was but one distinctively Western

THE VICE-REGAL PROCESSION AT THE INDIAN DURBAR, HEADED BY LORD AND LADY CURZON.

feature in the whole display. Beside the Viceroy in the same howdah, sat Lady Curzon, beside the Duke of Connaught, the King's brother, and his Duchess, a thing not seen in Indian since Alexander retreated from the Punjab.

THE GREAT PYRAMIDS

Not least among the wonders of the world are the Pyramids of Egypt. These stupendous monuments of an ancient dynasty stand on the right bank of the Nile over against Old Cairo. The eye follows with amazement the graded lines of the prodigious masses, showing in the light the profile of their rugged slopes, disposed in flights of fractured steps. They resemble mountains hewn into square blocks rather than structures raised by mortal hands, revealing at it were "the transition between the colossi of art and the giant works of nature." "All things fear time,"—says the Arab proverb,—"but time fears the Pyramids."

"CHEOPS"—THE GREATEST OF THE PYRAMIDS.
The Sphinx.

THE PYRAMID OF CHEOPS.

The Pyramid of Cheops, or Khufu, the largest of the three, is estimated to cover an area of over 12 acres, while its four triangular sides present altogether a surface of no less than 20 acres in extent. A quantity of material measuring 90,000,000 cubic feet was brought from great distances by way of the Nile, placed on the rocky foundations, raised to a height of over 500 feet, and adjusted with the greatest care.

HEIGHT OF THE PYRAMIDS

The Pyramid of Cheops, diminished by about 40 feet through the loss of its stone facing and the subsidence of its foundations, has a present height of 456 feet; that of Khephren, or Kephra, about 450 feet; while that of Mycerinus, or Menkera, has less than one-half of these elevations. There are several others on the plateau, of smaller dimensions.

AGE OF THE PYRAMIDS OF GIZEH.

Those above named are known as the Pyramids of Gizeh, which is a village in the vicinity. They were constructed during the Memphite Dynasty, which began, according to different authorities, 4235, 3733 or 3666 years before Christ.

TRAVELERS CLIMB TO THE TOP OF CHEOPS.

Travelers often ascend the Pyramid of Cheops before dawn in order to contemplate the morning sun lighting up the limitless spaces of the desert in one direction, and in another, the verdant plains with their dark groups of hamlets, and the silver lakelets left by the last overflow of the Nile.

CLIMBING TO THE TOP OF THE PYRAMIDS—EGYPT.

SCENES OF GREAT FINANCIAL PANICS

The remarkable monetary crises during the 19th century were as follows:

1814—In England, 240 banks suspended.

1825—In Manchester, the failures amounted to £2,000,000.

1831—In Calcutta, the failures aggregated £15,000,000.

1837—In the United States, this was the time of the "wildcat" crisis; all banks closed.

1839—The Bank of England was saved by the Bank of France. The crisis was severe also in France, where 93 companies failed for $20,000,000.

1844—In England, the government loaned to merchants; the Bank of England was reformed.

1847—In England, the failures amounted to $20,000,000; discount was 13 per cent.

1857—In the United States, 7,200 houses failed for $111,000,000.

1866—In London occurred the Overend-Gurney crisis; failures exceeded over $100,000,000.

1869—September 24th of this year was Black Friday in New York (Wall street).

1873—Many banks failed and great commercial enterprises were driven to the wall in the United States.

1893-95—The question of a silver or gold standard was greatly agitated, and the United States passed through a financial crisis which wrecked thousands of business firms and brought on general financial disaster.

SCENES OF GREAT FLOODS

Nine years after Christ, the Thames overflowed and destroyed a number of the inhabitants living along its banks. Another flood, A. D. 323, destroyed all the inhabitants in Ferne Island, seven miles southwest from Holy Island. In A. D. 3,535,000 people were lost in Cheshire by flood. An overflow of the Dee drowned 40 families in 415 A. D.; an inundation of the sea at Norfolk, Suffolk, and Essex occurred in 575; an inundation took place at Edinburgh, which did great damage, A. D. 730; there was an inundation at Glasgow, which drowned nearly 400 families, A. D. 738; also an inundation of the Tweed, which did immense damage, A. D. 836; an inundation of the Medway occurred A. D. 861; and another took place at Southampton, which destroyed many people, A. D. 935; the Severn overflowed and drowned hundreds of cattle in 1046; the sea overflowed 4,000 acres of Earl Goodwin's land, in Kent, since called Goodwin Sands, in the year 1100; a great part of Flanders was overflowed by the sea in 1108; an inundation of the Thames for about six miles occurred at Lambeth in 1243; and another took place on the Dollert Sea in 1277. At Winchelsea, 300 houses were overthrown by the sea in 1280; 120 laymen, and several priests and women were drowned by an inundation at New Castle-upon-Tyne in 1339. There was a flood at the Texel, which first raised the commerce of Amsterdam in 1400; the sea broke in at Dort, drowned 72 villages and 100,000 people, and formed the Zuyder Zee in 1421. In 1530 the Holland dykes broke and $400,000,000 worth of property was lost. In February, 1735, a flood occurred at Dagenham, and upon the coast of Essex, which carried away the sea walls and drowned several thousand sheep and cattle. Another, at Billboa, in Spain, destroyed property valued at 3,000,000 livres, in April, 1762. At Naples, a flood carried away a whole village, and drowned 200 of the inhabitants, November 10, 1773. At Navarra, in Spain, in September, 1787, 2,000 people lost their lives, and all the buildings of several villages were carried away by currents from the mountains. A terrible inundation of the Liffey, in Ireland, did considerable damage in Dublin and its environs on November 12, 1787. At Kirkwald, in Scotland, the breaking of the Dam-dykes, October 4, 1788, nearly destroyed the town. The melting of the snow caused floods almost throughout England, and the greater part of the bridges were either destroyed or damaged in February, 1795. A flood occurred at St. Domingo, which destroyed 1,400 persons in October, 1800. The coast of Holland and Germany

was overflowed in November, 1801; there was a flood in Dublin and parts adjacent December 2 and 3, 1802.

THE JOHNSTOWN FLOOD.

The flood, in June, 1889, at Johnstown, Pennsylvania, was caused by the breaking of a dam on the upper waters of the Conemaugh River. which confined a great lake on top of the Allegheny Mountains. Several small towns and the city of Johnstown were swept away, and 6,111 persons perished. The water in its passage to Johnstown descended about 250 feet. The theoretical velocity due to this descent would be about 127 feet per second, or between 86 and 87 miles an hour. According to the best accounts from 15 to 17 minutes were occupied in the passage to Johnstown, a distance of about 12 miles. Thus the average velocity could not have been far short of 50 miles an hour. The impetus of such a mass of water was irresistible. As the flood burst through the dam it cut trees away as if they were s'alks of mullein.

THE GALVESTON FLOOD.

In September, 1900, a hurricane along the southern coast of the United States reached the climax of its fury at or near Galveston, Texas, at 1 o'clock at night. It literally blew the Gulf waters over the island on which Galveston is situated, causing a loss of life and property unparalleled by any similar disaster in the United States. The city of Galveston was well nigh annihilated, 7,000 lives being lost and $30,000,000 worth of property destroyed. This appears the more frightful in view of the fact that the population was less than 40,000. Thousands escaped by clinging to the wreckage of houses and ships, which the wind blew far inland on the high tide. About $1,000,000 was subscribed throughout the country for the relief of the sufferers from this disaster.

SCENES OF TEN TERRIBLE PLAGUES

During the years 1656 to 1871, there occurred ten great plagues, which are remarkable for the large number of lives destroyed. The dates and places are as follows:

Date.	Place.	Deaths.	Duration in Weeks.	Deaths per Week.
1656	Naples	380,000	38	13,600
1665	London	68,800	33	2,100
1720	Marseilles	39,100	36	1,100
1771	Moscow	87,800	32	2,700
1778	Constantinople	170,000	18	9,500
1798	Cairo	88,000	25	3,500
1812	Constantinople	144,000	13	11,100
1834	Cairo	57,000	18	3,200
1835	Alexandria	14,900	17	900
1871	Buenos Ayres	26,300	11	2,400

COUNTRIES SMITTEN BY THE GREAT FAMINES OF HISTORY

Walford mentions 160 famines since the 11th century, namely: England, 57; Ireland, 34; Scotland, 12; France, 10; Germany, 11; Italy, etc., 36. The worst in modern times have been as follows: That in France, 1770, 48,000 victims; Ireland, 1847, 1,029,000 victims; and India, 1866, 1,450,000 victims.

THE CULTURE OF TAPIOCA

Tapioca is probably a native of Brazil, but is also largely cultivated in Peru, Guiana, Venezuela, the West Indies, South India and Malaysia. The bitter kind, which is more productive than the sweet species, is propagated by cuttings from the ligneous part of the stem, planted in rich, dry soil. The tubers are ready for digging up in from six to twelve months, according to the variety.

TAPIOCA PLANTATION.
Malayan, Peru.

There are two modes of preparing the starch. In the wet method the grated root is placed in water for about five days, then kneaded with water, and pressed to extract the juice. The fecula is sifted and baked in earthen ovens, some fresh manioc paste, which has fermented being always added. In the dry process the root is rasped by hand, and, after adding water, is pressed; after drying and sifting it is baked. The fecula deposit is washed three times and sun-dried. The collected starch, heated on iron plates, becomes partially cooked and agglomerates in small, hard, irregular lumps, constituting tapioca.

The culture of tapioca is inexpensive and the product is highly remunerative, so that the growth of the plant is becoming very general throughout the tropics.

COTTON CULTURE

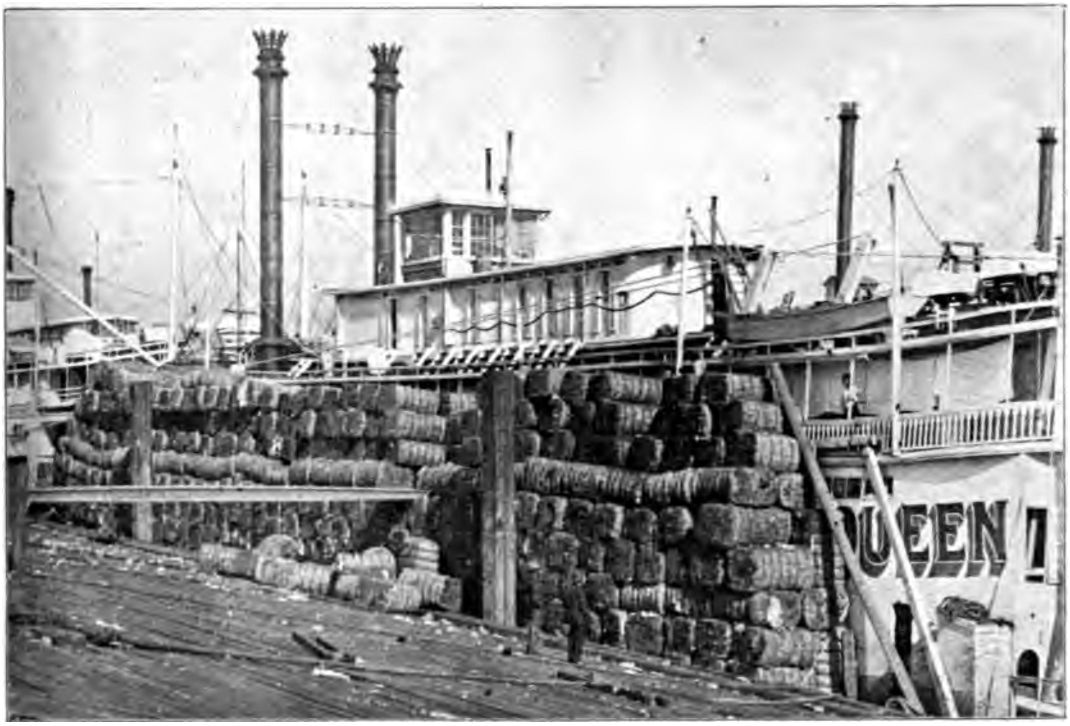
Herodotus, surnamed the Father of History, who was born B. C. 484, traveled through Europe, Asia and Africa, and when in India, saw and described the cotton plant. He says: "The wild trees in that country bear for their fruit fleeces surpassing those of sheep in beauty and excellence, and the natives clothe themselves in cloths made therefrom."

SELF PERPETUATED IN ANCIENT TIMES.

In those ancient times the cotton plant perpetuated its own species through the dispersion of its seeds by the winds. The root of the plant is top-shaped, and penetrates very deeply into the earth.

VARIETIES OF COTTON IN AMERICA.

In America are no less than 130 varieties of cotton. Among the chief commercial types is the "Gossypium Barbadense," which is indigenous to the Lesser Antilles,



LOADING COTTON, NEW ORLEANS.

and is extensively cultivated in the United States, as well as in the West India Islands, Central America, Western Africa, Bourbon, Egypt, Australia and the East Indies.

BRAZILIAN COTTON.

Another variety of cotton is cultivated very extensively in the coast region of Brazil. Just after the Civil War the cotton export from Brazil was over 100,000,-

000 pounds per year. It afterwards fell to 50,-000,000.

Pernambuco, Parahyba and Alagoas are the chief producers of cotton in Brazil, although its culture extends as far south as Rio Grande do Sul. It requires little labor in that region, and a very limited capital is sufficient.

PORTION OF LARGE SOUTHERN COTTON PLANTATION.

The height of the species common to the United States varies from three to four feet, if cultivated as an annual, and from six to eight feet, if allowed to grow as a perennial. When in full leaf and flower, it is a most graceful looking plant. Yarns having the finest counts, as they are called, are all spun from Sea Islands, which belongs to this class.

A THREAD 160 MILES LONG.

A single pound of this cotton is often spun in a thread 160 miles long.

In the United States cotton is cultivated in North Carolina, South Carolina, Georgia, Florida, Arkansas, Tennessee, Alabama, Mississippi, Louisiana and Texas.

In the beginning of the 19th century South Carolina produced more cotton than any other state. Fifty years later, Alabama went to the front. Ten years later, Mississippi led, and in 1890, Texas was first, with 1,471,242 bales.

COTTON PICKING.

HAULING COTTON TO THE GIN.

Late in July, or early in August, the cotton pods begin to show a few ripe open bolls, and the sacks and baskets are made ready for picking. Picking cotton must be done under a shining sun, and is very wearisome work. After being picked it must be carried to the gin house before the night dews touch it.

At present most of the cotton produced in the world is ginned by machinery. Gin-

BALES OF COTTON AS IT IS PICKED.

ning consists in separating the cotton from the seeds. From 66 to 75 pounds of seeds are got from every 100 pounds of seed cotton. After this process, it is gathered into bundles and roughly baled. Then it goes to the "compressors," where it undergoes, under enormous pressure, great reduction in bulk. After this, it is subjected to several important processes before being ready for commercial use.

GREAT VALUE IN COTTON SEED.

In no direction have modern processes for the utilization of so-called waste material produced larger or more gratifying results than in the conversion of cotton seed into a valuable commodity.

Forty years ago there was no use for cotton seed, the decaying accumulations of which were a menace to the health of Southern communities. In 1900, when 53 per cent of the seed produced was utilized, the planters received $28,632,000 for seed sold to the oil mills, and the value of the products of those mills was $41,411,000. Half (46,902,000 gallons) of the oil made in that year was exported. To invest an article with a value of millions of dollars which, 40 years ago, was deemed worthless, is certainly an achievement worthy of a place among the miracles of modern times.

COTTON COMPRESS AT BIRMINGHAM, ALABAMA.

BOOK IV

A THOUSAND THINGS WORTH KNOWING

INFORMATION THAT ENRICHES THE MIND AND ENLIVENS THE HEART

FIRE FIGHTING TO-DAY

THE American system of fighting fire is considered the most perfect in existence. That the American mind, which runs to mechanical devices and machinery, has something to do with it, there can be no doubt.

The Germans and French say that we ought to have the best fire departments in the world, because we have more fires than any other country, and, consequently, more experience in fighting them. Our force is nearly four times that of Germany or France in proportion to the population, and three times that of England.

Geo. Washington Fire Engine, Presented to the City of Alexandria, Va., by Geo. Washington.

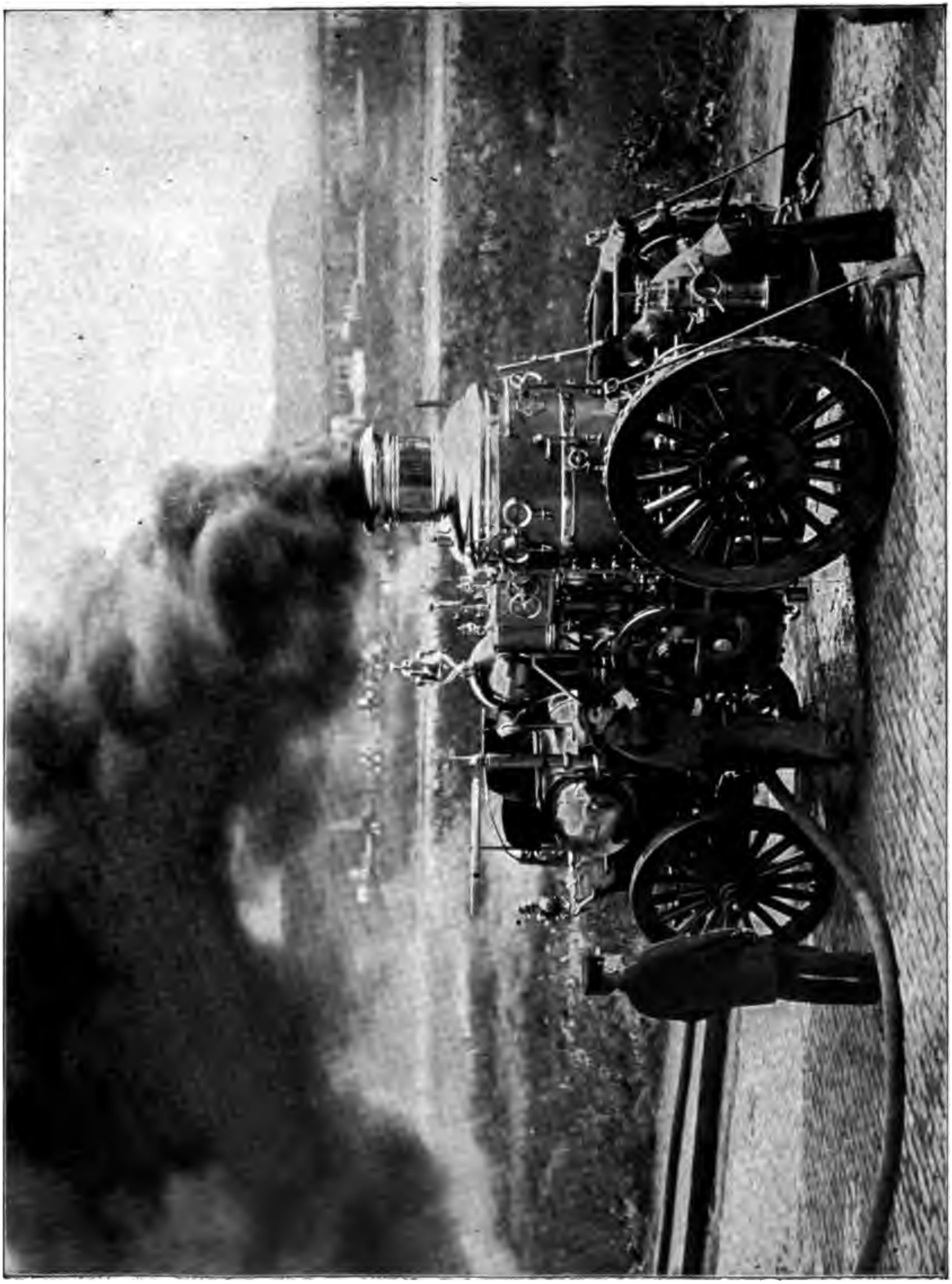
FREQUENCY OF FIRES IN AMERICAN CITIES.

There are several reasons why our American cities should have more fires than European cities. In the first place, the wooden structures, common in earlier years, made our cities almost as vulnerable to fire as are the Chinese and Japanese towns of today, where fire sweeps away whole quarters almost periodically. The value of one solid structure as a stay to fire has been shown over and over again in the last twenty years. In the second place, our climatic conditions favor the fire fiend. In European countries, the temperature is comparatively equable; here, we always have a tropical summer and a rigorous winter. After a summer heat that dries everything to a tinder, we have sudden-cold calls for the lighting of every stove and furnace. The sudden overheating results in fires. It may be also added, that European econom-

ists mention our prosperity as a reason for our many fires; we bear, without complaint, a yearly fire loss that to Europeans, seems a wicked and unnecessary waste. Our American fire houses compare favorably with those of Europe, although some of the English cities provide better accommodations in the way of gymnasiums and baths than any of our departments.

SELF-PROPELLING STEAM FIRE ENGINE—ENGLISH STYLE—LONDON, ENGLAND, FIRE DEPARTMENT.

COMBINATION COMPOUND BABCOCK CHAMPION CHEMICAL ENGINE AND HOSE WAGON, WITH DECK TURRET NOZZLES.



AMOSKEAG SELF-PROPELLING STEAM FIRE ENGINE.

By courtesy of the Fire Extinguisher Mfg. Co. BOSTON, MASS.

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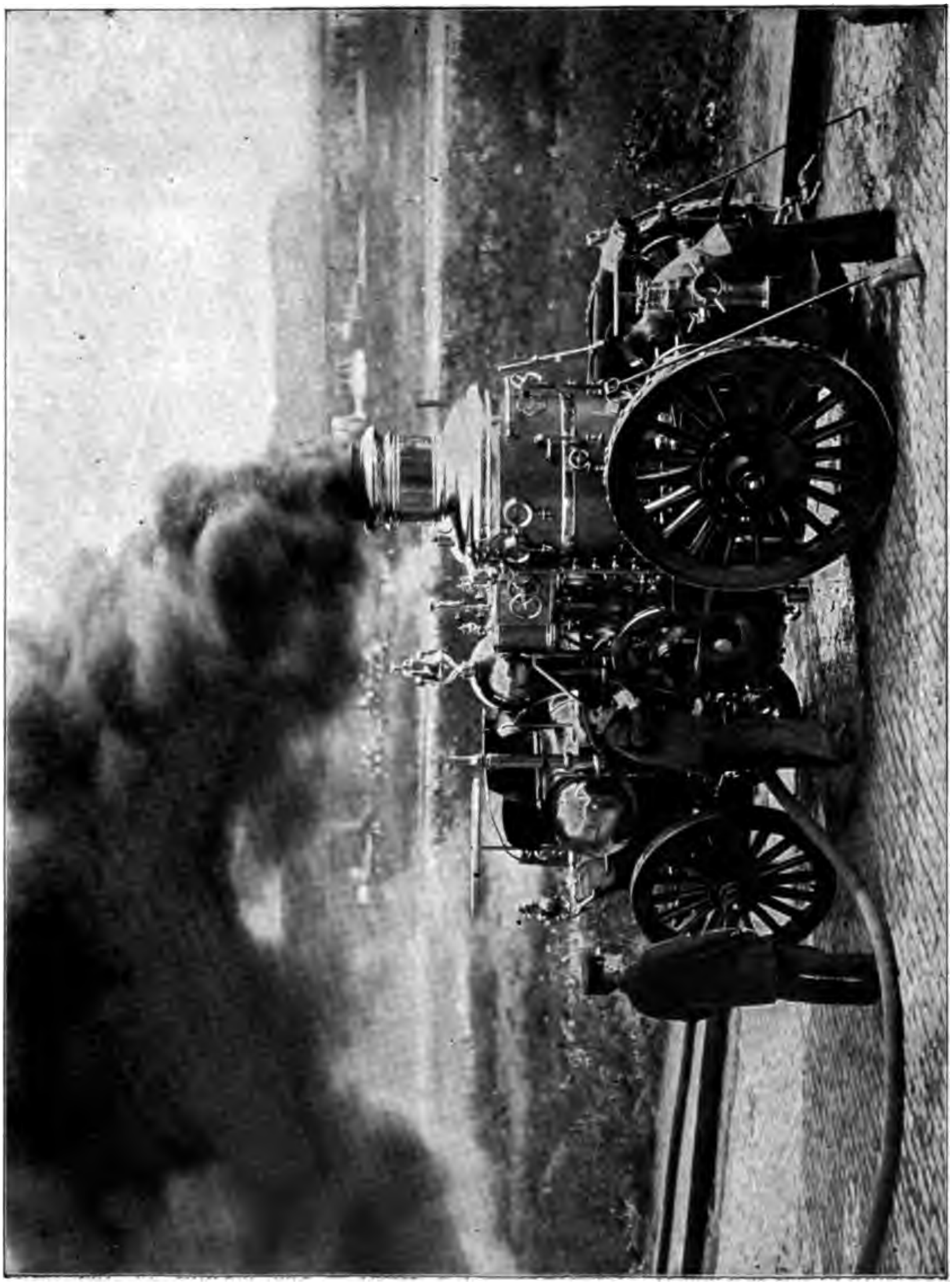


AMOSKEAG SELF-PROPELLING STEAM FIRE ENGINE.

By courtesy of the Fire Extinguisher Mfg. Co. BOSTON, MASS.

One difference between London and Chicago is that there the fire stations offer living accommodations to the wives and children of the married men.

GLASGOW'S SUPERB FIRE-ENGINE HOUSE.

Glasgow boasts of an even finer fire house than London can show. Its headquarters fire station, opened in 1898, is a six-story building, with a granite and marble front.

The walls of the rooms where the engines and trucks stand are of highly polished onyx and granite. The building contains a large sitting-room, billiard room, and gymnasium. The fire station cost $300,000, and is, probably, the finest in the world.

VALUE OF TIME IN FIRE FIGHTING.

There is no business in which the value of the stitch in time tells more than in fire fighting. The insignificant burning of a window curtain may, in two hours, become a blaze before which a thousand men and an equipment costing millions of dollars will stand helpless. Therefore the finest record of any department is likely to be found in the number of small fires put out before they become dangerous to property and life.

CHICAGO'S FIRE DEPARTMENT.

The last printed report of the Chicago fire department, which may be taken as typical of that in this country, shows that in 1901, out of a total of 5,135 fires, the loss, at 1,716 fires, was less than $10. At 1,334 fires, the loss was between $10 and $50; at 1,074 fires, the loss was between $100 and $1,000.

On paper, the record of an ordinary day's work by our fire department—the extinguishing from ten to fifteen insignificant blazes, with a loss of from $10 to $25 a piece—looks insignificant. In reality, it is one to be proud of, for it shows that the vital elements of a perfect fire department—the ability to put out the blaze in as few seconds as possible, the ounce of prevention, has been attained. The $25 fire is not a spectacular affair, yet it is the one over which the fire department may really take pride. The gradual decrease in the average loss per fire attests the value of its work. In 1876-1880, the average loss at important fires was $2,786; in 1896-1901, it had fallen to $876. As already said, the first aim of a perfect fire department is to put out the fire as soon as possible; and to this end every important device introduced in the last thirty years has tended. First, find out where the fire is; second, get the extinguishing apparatus there as fast as possible; third, put out the fire, using any device that serves, with as little loss to property as possible.

THE ELECTRIC FIRE ALARM SERVICE.

In early times fire towers were used extensively, but these gave way in 1873 to electricity, which became known as the electric fire alarm system. Chicago alone has something like 2,600 stations, or fire alarm boxes, attached to poles distributed throughout the city. Then there are hundreds of "watch service" fire call boxes which are located in private stores, manufacturing establishments and at the big packing houses. The directions on each box, which are painted red and are surmounted by a red light, are: "Turn the Handle to Right Until Door Opens. Then pull inside Hook Once and Shut the Door." The opening of the door

of the box rings a bell in the door, which is intended to notify anyone in the neighborhood, especially a policeman, that the box has been opened. When the inside lever is pulled down and let go, it sets in motion a certain clock work that ticks out the number of the box three times in succession at headquarters. Not only that, but it makes a record upon a tape, showing the number of the box and the exact second at which the lever was pulled. An operator, who sits night and day beside the instrument at headquarters, notes the number and selects from a drawer a certain disk, which, when placed in the proper apparatus, causes the alarm to be rung in all houses throughout the city. The average time for sending out an alarm to all parts of the city is about ten seconds.

FIRE FIGHTING IN LONDON.

In London the signal from a street station sounds in the nearest firehouse. The objection to this is that that particular engine may be out, which might mean much before another engine could be notified. At headquarters, the moment an alarm is sent out which calls away an engine, a note is made of it upon a frame or chart, which shows at a glance the sign "out" opposite the engine's number. When the company returns to the house, the first thing the captain does is to report the return of his company to headquarters. When an alarm is received at the engine house, all is orderly excitement. The chains fall down from in front of the horses, allowing them to run to their places in front of the engine or hose trucks, the men come sliding down the brass poles from the story above, and the collars are snapped around the horses' necks, and, by the time the signal stops, all is ready for a dash out of doors or a quiet return to quarters.

AWAY IN TEN SECONDS FROM THE ALARM.

The equipment that makes the departure of a fire engine from its house possible inside of ten seconds after the first clang of the alarm bell, with steam up and its regular crew, is the result of many inventions and persistent drill. As it is essential that no time be lost in getting up steam in the engine, steam is always maintained under a pressure of from five to twenty pounds in the engine boiler by means of a stationary boiler in the basement. This is connected with the engine by a pipe which is disconnected automatically when the horses start off. At the same instant the fireman lights the fire under the engine boiler with a handful of oil waste, and by the time it has gone two blocks, there is a blaze of hot coals and a head of steam to work with. Electricity drops the stall chains in front of the horses at the same time it begins to ring the alarm. The men, who sleep with one eye open, come down the poles faster than they could tumble down any staircase.

THE FIRE HORSES.

The fire horses, two for light engines, and three when the machines weigh more than four tons—are trained as finely as the men. They are the pets of the house and of the neighborhood. Some of them learn in a week to run to their places at the signal; others require a month's training. The lessons are simple enough. A raw horse is made to feel the whip as he hears the signal bell. If he is an intelligent animal, the two so soon become synonymous that he starts for his place the instant the bell rings. Many horses seem to know quite as

well as the men, when the alarm is one that means business. They really seem to count the strokes.

ELECTRICITY FOR FIRE ENGINES.

It is highly probable that the days of the fire horse are numbered. Steam as a motive power for fire engines, although used in several American cities, and in many European ones, has never found favor in Chicago. The difficulty in getting up power quickly enough seems to be the trouble. Electricity, however, which is now used in Paris and Berlin, is pretty certain to displace the horse within the next few years. Its chief advantages are that it makes a quicker start possible than with horses, and that the same power which propels the machine through the streets can be used for pumping-apparatus when the fire is reached. Moreover, no fire is needed, thus doing away with lots of smoke and noise that add to the confusion inseparable from any fire alarm. Another fact in favor of electricity is that if, as so often happens, there is no fire worth talking about, or one that can be put out with an extinguisher, there is no loss of fuel and labor. At present, every engine is expected to arrive at the fire with its own fire blazing hot. The cleanliness and neatness of an engine house that requires no boiler, handles no coal or ashes, and keeps no horses on its premises, may be imagined. Heretofore, it has been objected that if electrical apparatus gets out of order the men are helpless, and, formerly, electricity was not so commonly used as at present; this may have had some force.

MODERN EQUIPMENT FOR FIRE-FIGHTING.

The modern equipment for fire fighting consists of engines for pumping water, hose for distributing it at the fire, various sizes and lengths being used, according to need, ladders for getting up into buildings, life-lines, and nets into which people jump, if they have to. Each hose-cart also carries two chemical extinguishers, having a capacity of fifty gallons each. In the last five years an average of forty fires a year has been put out with the aid of these extinguishers alone. The ladders are of various types, from small ones, to be carried by the firemen, to the extension ladders raised by a crank, which reach to a height of ninety feet, or to the sixth story of an ordinary building.

COMPRESSED-AIR EXTENSION LADDER.

One of the most interesting novelties shown at the Paris Fire Congress of 1900 was an eighty-five-feet extension ladder from Frankfort, Germany, built on the telescope plan, and raised by compressed air to its full height in 25 seconds.

THE SCALING LADDERS.

The scaling ladders used by firemen, to climb up the outside of a building where ordinary ladders fail, consist of long poles into which crosspieces, or rungs, are inserted, by which a man may climb. At the end of each pole is a long spike-projection, to be thrust through the window sash. With a supply of such ladders trained firemen can get to the top of a building in an incredibly short time.

THE WATER TOWER, SEARCHLIGHT AND GUN.

It is largely a matter-of-practice period. In addition to all this apparatus, there must also be mentioned the water tower, which raises a hose nozzle to the level of the upper stories, a searchlight, for use upon dark

nights, and a gun, by which a rope may be sent up to the tops of buildings.

In the fireboat Illinois, Chicago has the most powerful and effective fire fighter in the world. There is a boat in New York that approaches it in completeness and capacity to throw river water, yet nowhere has it an equal. The Illinois was built in the year 1888, and is the newest and most modern fire boat that floats. The Illinois is 118 feet in length, twenty-four feet in depth, and has a hold depth of twelve and a half feet. To construct and fit it out cost about $100,000. In viewing it from some distance an uninitiated observer might well take it for an engine of destruction instead of saving warfare, for its big brass bores at the bow and stern suggest the shell-throwing howitzers we read about. The Illinois is throughout protected from fire, its exterior and interior being metal plated. The hull of the boat has two novel features suggested by its liability, in the winter season, to meet ice obstructions. The prow does not extend down into the water the usual depth, while the bottom line of the vessel slopes upward, so that when the boat encounters ice in hurrying to the scene of a conflagration, it glides upon it, and its own weight carries down the ice.

All the machinery of the Illinois is below the water line. There are six double cylinder engines, three of which supply the power of operating the great double pumps which rush the water through the stand pipes and hose lines. The other three engines run the electric dynamos and supply motive power to the boat. So powerful are the pumps of this boat that eleven streams of water may be thrown at one time, or a double stream may be shot up to a distance of one hundred and ninety feet.

WHAT A POUND OF COAL CAN DO

Considerable interest has been evinced as to what a pound of coal could do. An experienced engineer has taken the time to figure out the power in a pound of coal and the results of his calculations are as follows:

ITS WONDERFUL POTENTIAL ENERGY.

A pound of coal can produce sufficient power to pull a large express train a distance of one-sixth of a mile, going at the rate of 50 miles an hour. A pound of average coal contains about 10,000 heat units. This would be somewhat smaller in size than a man's fist. If this pound of coal could be burned completely and entirely under water, and all of its heat should go into the water, 625 pounds of water could be raised to the height of one foot.

THINGS ALMOST INCREDIBLE.

If the same pound of coal could be burned in water one foot deep, with a temperature of 64 degrees, and all the heat from this coal should be imparted to the water, it would become 16 degrees hotter, thus being suitable for a bath. If adapted to mechanical work, the 10,000 heat units in one pound of coal would be equivalent to 236 horse power. This amount of potential energy is sufficient to haul a train of eight cars for a period of one fifth of a minute, or a distance of one sixth of a mile. It is also capable of drawing a cable train, in-

cluding the grip car and trailer, for a distance of two miles, at the rate of nine miles an hour. It will also pull an electric car well filled with passengers for two miles and a half, at the rate of ten miles an hour.

Compared with the work of a strong man, this pound of coal would do the work of five men for one minute. Another line of work in which the superiority of a pound of coal is shown beside the labor of a man, is that of sawing wood. A man may consider himself a swift sawyer by making sixty strokes a minute, each stroke of the blade having progressed five feet a minute, but a circular saw drawn by machinery, may be put through 70 times that distance, and saw 70 times as much wood. Still, this little pound of coal has the power to keep in operation 180 such saws.

THE CYCLONE

The general ideas on the subject of cyclones are rather vague. Take a small butter pot, and set it down on your largest map of the world at about 20 degrees north latitude, anywhere in the Atlantic between two continents, say east of the West Indies.

ITS PATHWAY.

Then, with a piece of whalebone twice as long as from the butter pot to the North Pole, bent into a parabola, with one end at the pole, the other at the butter pot, mark out thus the path of the cyclone. The apex of the bent whalebone will be somewhere in the western United States. Imagine your butter pot to be revolving on its own center in the manner of the hands of a watch, at the rate 100 miles an hour.

ITS EDGES.

Its northwestern edge will be the dangerous storm rim, blowing a hurricane, lashing the seas, and precipitating the rain; the other edges will be breezy, but not so stormy, as they contain less moist air.

ITS CENTER.

The center will be the low barometer and calm area, because here the air has less weight and is flowing upward. Now, move your pot slowly along the parabola, still supposing it to be turning. By the time you reach the center of the United States, exchange the pot for a saucer, with the same supposed conditions, only by this time, if wintry, a snow storm will take the place of the rain. Keep it moving circularly, and northward also along the parabola, and about Hudson Bay, change to a breakfast plate, and in Greenland, to a dinner plate, and about the 80th degree north, before the storm reaches the size of a buggy wheel, it breaks up.

ENLARGEMENT OF THE STORM SPACE.

Thus you see the space over which the storm travels enlarges as it passes north, the winds blow around its rim, and the calm center moves with it.

THE HORN CARD.

Mariners now carry what is called a horn-card, a transparent piece of flat cow's horn, with a circle on it, inside which are several smaller circles, with arrows pointing as a watch's hands travel. Whenever the barometer changes and clouds scud

by, this horn-card is placed on the chart at the ship's position. Knowing the wind's direction and the weight of the air, the horn-card tells whereabouts in the cyclone's course the ship is, and from this is reasoned how to sail to avoid its violence, or if unavoidable, how to manage in it, and if possible to profit by it.

HOW THE CYCLONE FORMS, DEVELOPS AND ADVANCES.

The formation and development of a cyclone is thus described by the intelligent observer of its progress, who furnished the accompanying illustration.

"In the afternoon a cloud of smoke was noticed on the horizon a few miles away. Spiral puffs arose from time to time, and we wondered whose house was burning. Presently we noticed a cloud in the sky above the burning house, of the same color, only darker.

"The cloud was quite a distance above, and entirely detached from the smoke below. While we looked a long finger suddenly descended from the upper cloud and touched the 'burning house,' and the two united and moved rapidly forward. Then we knew there was no burning house, and that we had witnessed the formation of a cyclone. Those who were nearer than we were told us that they first noticed a little whirl of dust, such as one often sees in a dusty road. Only a foot or two high at first, it usually scatters and disappears in a few minutes. This one did not. It rapidly grew larger and clung to the same spot. The cloud we saw in the sky did not come from anywhere. It suddenly formed in the sky above the little whirl of dust, grown larger by that time.

TWO CLOUDS UNITE.

"The two clouds moved forward at once on uniting. The long finger thickened at the top, forming an inverted cone. The lower cloud became absorbed in the upper, forming an immense, funnel-shaped, whirling horror, of inky blackness. Flashes of lightning constantly darted forth from its sides, and a sullen, thunderous roar was continuous. It moved with a swaying, graceful motion, rising and falling with the inequalities of the ground. It seemed to move slowly. A good horse could outrun it. As the long finger swayed back and forth whatever it touched vanished.

"Houses, barns, haystacks and trees, all

By courtesy of "The Oaks."
A CYCLONE AS IT STRIKES.
(From a photograph.)

were taken up by the suction of the cyclone. The whirling motion was so rapid the eye could not follow it, but the forward movement was so slow that anyone who saw it in time could easily get out of its way. For that reason few lives were lost. It lasted three-quarters of an hour, then it struck a slight shower cloud and dispersed. Its track was eighteen miles long and one-quarter mile wide. It came within a half mile of our home. The courageous photographer who took the picture was handicapped somewhat by his shrieking family clinging to him and trying to get him into the cyclone cave.

"The photograph does not do justice to the 'sitter,' as at the moment of taking the shot it was passing over a plowed field, and the dust it kicked up destroyed the symmetry of its funnel. There was no other cloud in the sky except the cyclone. We could see the blue sky above and on all sides of it all the time, in unique and startling contrast."

HOW MUSIC IS PRINTED

Millions sing popular songs, but few know what a page of music represents. Just to give an idea of the subject, it may be put down in the outset that an ordinary piece, of three sheets, selling for 10 cents, involves the use of more than 5,000 separate types.

Chicago is one of the great music publishing centers of the country, and its daily output ranges through all the grades of vocal and instrumental literature—from the symphony for a full orchestra, reproduced for the first time from the manuscript of the Chicago composer, to the cheapest reprint of the newest thing in concert hall music.

WOMAN IN MUSIC PRINTING.

Woman is on an equality with man in this department of the publishing trade. She commands a man's wages for "composition," and, as the work is of the most delicate and perplexing kind, her patience and dexterity usually give her a marked superiority over the men of the guild.

DIFFERENT METHODS IN PRINTING.

A composer with a piece of music to publish has his choice among four kinds of printing. If he is rich, he may have the score engraved on copper and printed as if it were an expensive picture, or he may have it stamped in zinc, or it may be lithographed. But if he is bent on money-making and celebrity, he will go to the musical type-setter.

THE MUSIC PRINTER'S CASE.

The case of the music printer is divided into 700 boxes, one for each character, and the compositor must have learned her case perfectly or she will be able to make poor headway with her work. First, she sets the character for the clef, and the end of the staff. Then she inserts the sharps or flats of the signature, and spaces out the staff with short pieces of brass rule. Next, she pieces to get her figures and staff rules to indicate the time.

THE NOTES.

Suppose the first note of the piece of music is a quarter-note in the second space,

with a sharp before it. The compositor puts in the sharp first and fills up the space with bits of brass rule to continue the staff; then she inserts the body of the quarter-note with two lines below, and above it puts the two types necessary to make the stem of the note, and to keep the staff unbroken. Sometimes five more separate types must be inserted. A measure of eight consecutive notes, three-four time and a tenor clef indicated, seem to contain ten characters. As a matter of fact, the number is 78, at the very least, and more if the measure has accidentals or complicated harmony. It takes about five years for an apprentice to learn the trade. It is not necessary to have musicians to set music type, yet in correcting proof it is the aim of the typesetters to know enough music to avoid errors.

MUSIC TYPE.

On this side of the Atlantic music type is made only in Philadelphia, and so great is its cost that it is never put to the wear and tear of the presses. As soon as the proof is corrected by the proofreader, the form of type is molded in wax and then an electrotype is cast from this matrix. After that comes the tedious work of distributing the several thousand types, for the wax sticks in between and makes the sorting of the type difficult.

LITHOGRAPHIC PROCESS OF ENGRAVING FOR MUSIC.

Next in importance is the lithographic process of engraving for music. A plate of zinc is ruled off with the series of five lines of the staff. Then the music is copied in reverse on the zinc, and the engraver, with many separate dies and punches, stamps in the notes, bars and rests. When this is done and the plate is hammered straight, it is filled up with thick transfer ink. An etcher's proof is taken of this, and while the ink is yet wet, it is pressed upon a lithograph stone. From this point the work of printing is the same as that of a one-color lithograph, that is, the stone is kept wet and the ink adheres only to the characters of the music.

Sometimes, to avoid expense in printing small batches, music is printed direct from the stamped zinc sheets. In this case bees-wax is filled into the lines and dots for some depth, as otherwise there would be so much ink taken up by the indentations that the sheet music would be blurred.

THE PROCESS OF PRINTING.

In printing the music, dampened paper is used. In the press, a heavy bed of iron supports the engraved plates with paper on them. By means of a big capstan wheel, this bed is moved in between two iron cylinders moving in the same direction. A heavy blanket of felt is wrapped about the upper roller, and the pressure causes the ink in the plate to be sucked up on the paper. These presses must be run by hand, and the plate inked and wiped off for each impression. Thus the cost of printing is about half a cent a sheet.

A BIG CLOCK

On the House of Parliament in London is a clock, the striking part of which takes one-half a day to wind up. The clock has four dials—one on each side of the square tower. See illustration on page 332 of this book.

HOW THE MODERN THEATER IS CONDUCTED

Something of the glamour of romance and mystery veils the world behind the footlights to those who have never lived within that mystic circle, but the life is anything but romantic and mysterious to the players and the workers.

THE THEATER WORKHOUSE.

On the contrary, while to the public a theater is a playhouse, it is, to those connected with it, something of a workhouse. Either a mental or physical effort is required almost every minute of one's working hours. The ceaseless routine of duties necessary to the completion of each production commences at the desk of the manager, who reads the manuscripts of countless plays, and selects the one he thinks will most please the public.

THE MANAGER'S SELECTION OF A PLAY.

These manuscripts are obtained either from the playwright direct, or from the playwright's agent. Accompanying each manuscript is a statement of the royalty to be paid for the plays used. This right of royalty sometimes costs the manager as much as $1,000 a week. There are plays that cost even more than that; but the average cost is about $500 per week.

WHERE COSTUMES ARE MADE.

THE STAGE DIRECTOR'S PREPARATIONS.

After the manager has selected a play to follow any given production, the manuscripts go immediately to the stage director,

who is the power behind the throne (footlights), and the autocrat of the world on and beneath the stage. It is his province to direct, and his duty to apportion, the various tasks involved in the mechanical construction and the mental preparation of a play.

After having read the manuscript the stage director begins "to plot," not like the villain in the play, but with pencil and paper. Using those business materials, he draws the scene plot, and several other minor plots, varying in number and importance according to the extent of the production.

THE SCENIC ARTIST, PROPERTY MAN. ELECTRICIAN AND STAGE CARPENTER.

This finished, he turns over the scene plot to the scenic artist, who immediately wrinkles his brows for an imaginative conception of an original interior or a fresh landscape. The stage director assigns the property plot to the property man, who begins to get the hundred and one articles that are to be a part of the coming production. The light plot goes to the electrician, who at once begins planning the light effects for this particular play. Still another plot goes to the stage carpenter, who

By courtesy of Geo. R. Lawrence, Chicago.
VIEW SHOWING PROSCENIUM AND BOX ARRANGEMENT OF A MODERN THEATER.
Illinois Theater, Chicago.

at once sets about with saw, hammer and nails to make such frames as are necessary.

THE ORCHESTRA LEADER.

The "plotting" does not end here, for, the leader of the orchestra, whose duty it is to select the proper character of music for each situation — something tremulous, for the tears, something lively, for laughter, and something heroic for the melodramatic, is given a "plot."

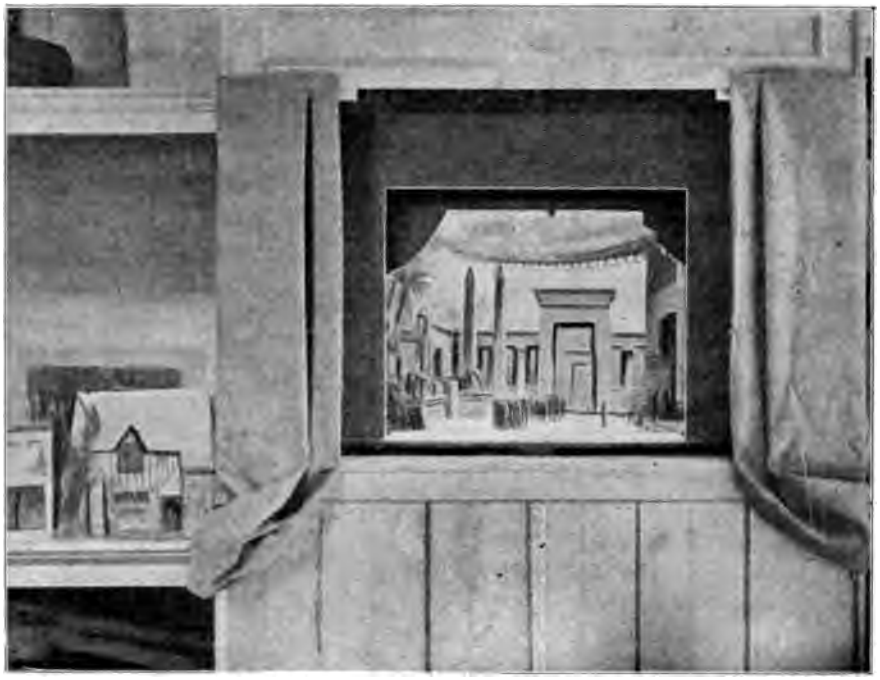
ASSIGNMENT OF PARTS.

These plots having been formed and distributed, the stage manager then proceeds to cast the play—that is, he mentally canvasses the individual talents of the members of the company and assigns to each one the part most suited to that person. Sometimes a player possesses sufficient versatility to fill any role, but such versatility is rare. Good judgment in assigning the parts is therefore an indispensable attribute of a good stage manager. Not every player, to be sure, is invariably assigned to the part he would most like to play, but the part he would most like to play is not always the part he could play best. As to that, the stage director is the judge, and upon the correctness of his judgment frequently depends the success of the production.

By courtesy of the Columbia Theater, Chicago.
WHERE SCENERY IS PAINTED.

UP IN THE "FLIES."

While the property man goes about the getting together of the "props" the scenic artists high up in the flies are busily working upon the scenery for the coming production. The paints are "cooked" and the colors blended upon such canvases as are to be used. For each production there is an entirely new outfit, giving a freshness of scenic investiture to each play that is practically impossible with traveling organizations.



By courtesy of the Columbia Theater, Chicago.
MODEL FOR STAGE SCENE.

MODERN FEATURES IN STAGE PRODUCTION.

In producing plays at the present time nothing is impossible. Lightning is made to go zig-zag across the stage at the will of the electrician, miniature lakes and fountains are the work of the stage carpenter and manager, and, in fact, so far advanced are the methods of the modern stage that a locomotive may be made to appear as if going through flames at a terrific rate of speed, while in fact it is absolutely stationary. Flame is often made with cloth and colored lights. Steam is made to take the place of smoke. The ear, too, is deceived as well as the eye, and thus the most realistic effects are achieved.

All this varied and elaborate procedure involves a large expenditure, which finds its return, with a very handsome margin of profit, in the patronage received from the theater loving public. The popular tendency to crowd before the footlights never seems to diminish, and if the plays are of the proper character, the amusement and edification obtained from witnessing histrionic productions constitute a wholesome diversion.

HOW LIQUORS ARE DISTILLED

Alcoholic liquors are made from materials containing starch or sugar in sufficient quantities to cause fermentation. If, after fermentation, the liquor is subjected to distillation it is called distilled liquor, and to this class belong whisky, brandy, rum, absinthe, etc. Brandy is made from fermented grape juice. The best grades of cognac brandy are made from white French wines; inferior qualities are made from Spanish and Portuguese wines. Whisky is made from the fermented extract of rye, barley or corn. In Scotland and Ireland malted barley is used—sometimes alone, sometimes mixed with other grains.

TESTING LIQUORS IN THE BUREAU OF REVENUE.
A sample of all liquors imported and exported is brought here and tested to decide the Revenue Tax to be placed thereon.

Bourbon whisky is made from rye and malted corn. Gin is produced by mixing common spirits with juniper berries. Frequently other materials are used for flavoring, such as cardamon seed and oil of fennel. Liquors are made from brandy and alcohol by flavoring them with aromatic substances, such as orange peel, absinthe and anise; then the flavored liquid is distilled, and after distillation, it is colored with caramel and sweetened in most cases.

THE MANUFACTURE OF WHISKY.

The manufacture of whisky will serve as a type for the manufacture of other spirituous liquors. The first step in the process is the saccharifying of the grain—that is, turning the starch into sugar. The grain is mixed with malt and ground in a suitable mill and then run into a mash tub,

where it is agitated with water at a temperature of 150 degrees Fahrenheit.

THE MASHING PROCESS.

The mashing process is continued until the starch is changed entirely into malt sugar or maltose. This requires from one to five hours, according to the amount of grain in the mash. Malt contains a substance known as "diastase," which possesses the remarkable property of turning starch into maltose or malt sugar. It is for this reason that malt is added to the grain in the mash tub. Starch is changed by prolonged boiling into dextrin, which does not ferment readily, while maltose ferments very easily. Great care, therefore, is taken during the mashing process that the dextrin formation is reduced to a minimum. This is done by keeping the temperature near 150 degrees during the whole process.

"WORT."

The liquor obtained in the mash tub is called "wort." When the wort is as strong as possible, it is drained off, and the grain is treated with a fresh supply of water and the wort so obtained is added to the first. The wort, on coming from the mash tub, must be cooled rapidly, otherwise an acid fermentation will set in which produces vinegar, and the presence of such substance is undesirable. The wort is cooled by allowing it to trickle over cold pipes, which are kept at a low temperature by some method of artificial refrigeration similar to that by which ice is manufactured. It takes about five hours to reduce the contents of the mash tub to a temperature of 60 degrees.

FERMENTATION.

The wort is now ready for fermentation. Fresh brewer's yeast, or softened compressed yeast, is added to the liquid, which is stored in wooden tanks in the cellar of the distillery. One gallon of brewer's yeast, or a half pound of compressed yeast, is used for every 100 gallons of wort. In the early stages of fermentation the yeast cells grow without producing much alcohol. Later, the malt sugar ferments and alcohol is formed; carbon bioxide is generated after the sugar is formed; the dextrin gradually is changed to maltose, and this is then changed to alcohol by fermentation. During fermentation the temperature gradually rises because of the chemical changes taking place. The temperature is kept near 93 degrees to get the best results. Fermentation is complete when no more alcohol forms, and this takes from five to nine days. The yeast is skimmed off, and the fermented wort at once is subjected to distillation.

DISTILLATION.

The object of distillation is to increase the percentage of alcohol in the liquor and at the same time to remove undesirable substances from it. The undistilled liquor contains alcohol, water, solid matter, fusel

By courtesy of the Sunny Brook Distillery Co., Chicago.
THE FERMENTER.

oil and other substances. Alcohol boils at 172 degrees, water at 212 and fusel oil boils, some at 207, and some at higher temperatures. If a mixture of such liquids be boiled and the resulting vapors be cooled the process is called distillation. If the liquid which distills over and is condensed be collected in different portions or fractions, the first fraction will contain a larger percentage of alcohol than the original liquid, for the alcohol distills off at the lower temperature. The remaining fractions will contain more water and fusel oil. The first portion will not contain all of the alcohol, nor will it be entirely free from water and fusel oil, but if it is redistilled the percentage of alcohol will be greatly increased and the amount of water and fusel oil will be diminished correspondingly.

THE OLD STILL.

The old stills were based on this principle, and many such stills are used today in Scotland and Ireland. They consist of large flat-bottomed vessels of copper set in brickwork and heated underneath by direct firing. The still is connected at the top with a long spiral pipe called a "worm," which passes through a tank of cold water, where the alcoholic vapors are cooled and the distillate is collected at the other end of the worm in a suitable tank. This method of distillation is wasteful of fuel and for that reason a number of devices have been introduced for reducing the cost of the product and increasing the quality.

By courtesy of the Sunny Brook Distillery Co., Chicago.
THE VAT.

THE MODERN STILL.

The improved stills are somewhat complicated in construction, and they are continuous in action; that is, the liquor to be rectified is fed in a steady stream without interruption to the process and the rectified spirits are drawn off continuously. A standard still consists of two columns made of wood, copper lined, called respectively the "analyzer" and the "rectifier." The analyzer is divided into a number of compartments by perforated copper plates, supplied with valves opening upward. Small pipes pass through each plate, projecting about half an inch above each plate and reaching down into small copper pans placed on the plate below. From the analyzer the vapors enter the rectifier, which also is divided into compartments with perforated plates until near the top of the column, which is free from plates. There the finished spirit is held back and carried away to the condensing worm. The liquor to be distilled is pumped through a zigzag pipe which circulates through the rectifier. When it reaches the bottom of the rectifier, it is entirely changed into vapor. The vapor then goes to the analyzer, which is heated from below by steam. The water condenses and runs off at the bottom of the analyzer; the vapors of the alcohol

By courtesy of the Sunny Brook Distillery Co., Chicago.
STOREROOM.

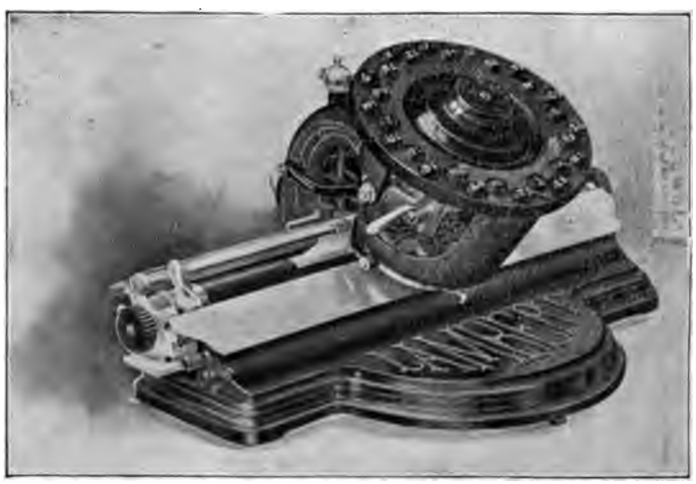
pass into the rectifier, where they circulate through compartments, and as they ascend they are almost entirely freed from water and fusel oil. The vapor then passes through a condensing worm, where it is thoroughly cooled and liquefies, running into storage tanks.

ADULTERATION AND IMPOSITION.

There is much adulteration and imposition in the manufacture of liquors. Sometimes sulphuric acid, blue vitriol, ammonia and acetate of potassium are used. A good deal of it is made by mixing a little genuine liquor with coloring matter and different oils to add proper flavor. Prune juice is a favorite flavor with compounders, and an extract of tea and currants is used for rye whisky. In order to make certain liquors foam properly in imitation of the genuine, they are treated with a beading oil made from the oil of bitter almonds. Bourbon whisky is made sometimes by adding fusel oil which has been treated with black oxide of manganese and the poisons just mentioned. "Scotch" whisky is made by adding to a small quantity of real Scotch whisky, oil of birch and spirits. Cognac is made from spirits by flavoring with cocoanut oil and coloring with burnt sugar.

A TINY TYPEWRITER

The pocket typewriter is the very latest device to lessen the labor of newspaper men, detectives and any and all persons who need to take notes on any subject when the use of pencil and paper would be an inconvenience. This new invention makes it possible for one to take down conversation, speeches or any remarks that he may choose to record, without even removing his hands from his pocket.



By courtesy of the Lambert Typewriter Co.
THE POCKET TYPEWRITER.

ITS SIMPLICITY OF DESIGN.

The inventor of this little typewriter is Eugene McClean Long, son of the late Confederate general, Long, of Charlottesville, Virginia. The feature of this unique little word recorder is its simplicity. Its casing is of hard rubber, and its interior, of aluminum. The dimensions of the casing are four inches by three inches.

ITS MECHANICAL OPERATION.

In the casing are two little spools, that hold rolls of tape quite similar to the white paper in the ordinary ticker. By merely pressing four keys on one side of the casing and by the manipulation of a space key and a number indicator, anything that the human tongue utters can be put down in symbols. In designing this typewriter, the inventor first observed that an instrument must be constructed which would make a separate and distinct sign for each letter of the alphabet, and of such a mechanism that these signs would be produced with greater rapidity than the corresponding words can be written with the pencil.

MAKING DIAMONDS BY ELECTRICITY

The prospect of the manufacture of diamonds by scientific means is now considered so likely as to be predicted in a government report. T. G. Martin, an expert agent of the census office, has written a long and interesting report on the electrical industries of the United States, in which he makes mention of the attempt to make diamonds by artificial means.

In this report Martin recalls the fact that Moissan, the French inventor, pushed the employment of the electric arc so far as to produce minute fragmentary diamonds in his furnaces. Moissan also noted the production of graphite from a diamond heated in the arc, and from the similar treatment of sugar charcoal purified by chlorine, and of purified wood charcoal. In fact, the investigations in this field tended to prove that diamonds are formed by the sudden cooling in mercury or lead, of molten iron saturated with carbon.

With these experiments before them, the world's chemists are now cudgeling their brains to ascertain whether, in all our modern electrical furnaces, diamonds may be produced.

CHEWING GUM AND ITS MANUFACTURE

Cleveland is said to be the headquarters of gum chewing and chewing gum. Probably more gum is made in that city than in any other. Chicago, however, is headquarters for the chewing gum trust and has become a great distributing point. About half the annual product of the trust, The American Chicle Company, is handled in Chicago. The output of the chewing gum combination amounts annually to 8,400,000 boxes of 100 pieces each, which, at one cent a stick, costs the public over $8,000,000 a year for a total of about 4,000 tons of gum. This does not count the amount

of white and spruce gum made by druggists and makers outside of the trust.

The first gum maker of prominence in this country was named Curtis. He founded a spruce gum factory in Portland, Maine, in 1835, which is still doing business. It is said that the ancient Egyptians chewed gum in the time of the Pharaohs and Cleopatra.

THE ZAPOTE TREE—CHICLE.

The gum sold today is made from a substance called chicle, which exudes from the zapote tree, a tropical fruit cultivated in Mexico and the Central American states. This fruit looks like a russet apple, tastes like custard, and when on ice, is like ice cream. The sap of the zapote tree is obtained by cutting a gash in the bark, and when it is boiled it assumes a heavy elastic quality not unlike rubber. Thomas Adams and his wife, of Brooklyn, on experimenting with it, learned that chicle would produce "rubber gum," and manufactured the celebrated "tutti frutti" gum, from which they made a fortune. Mr. Adams is now a director in the trust and was the first millionaire who made his money in chewing-gum.

William J. White, of Cleveland, is the second millionaire of the chewing-gum product. Formerly he used to peddle his own gum about the streets. In 1887, he brought out a gum flavored with peppermint which was very popular. Another man who has made a fortune is Dr. Beeman, of Cleveland, who was formerly a druggist. One day his clerk, Miss Horton, suggested that pepsin be added to gum to aid in digestion. The idea caught well with the public and made the two rich, besides the man who promoted the business.

HOW CHEWING GUM IS MADE

Gum is made by boiling the chicle in a huge kettle of steam. First the raw chicle is shipped to this country very dirty and has to be cleaned. This is done by melting it down before it is sent to the gum factories. When the gum is being boiled, at a certain stage, sugar, cream paste and oil of wintergreen or other flavoring extracts, are added. A revolving paddle keeps the stuff stirred up and it continues to cook until the critical time comes for it to be removed from the fire. It needs a "gum eye" in the cook to tell when the chicle has boiled long enough. If it boils too long the gum is too brittle; while if it is not boiled long enough, it is sticky and soft. It is said there are only twenty-five persons in the world who can boil gum just right, and that the chewing-gum millionaires had this faculty, which tended greatly toward their success. After being cooled the chicle is kneaded like bread, only that the finest pulverized sugar is added instead of flour. When it is just thick enough the loaves are flattened out, cut up, and rolled through a machine. The sticks are then wrapped and are ready for market.

The habit of chewing gum has become in recent years one of the most prevalent indulgences observable. It is safe to say that two-thirds of the boys and girls in attendance at the common schools chew gum continually. While it is not a commendable practice, it is not open, fortunately, to the objections that pertain to the chewing of tobacco, or the use of certain other articles that satisfy the taste, but leave their effects upon the system in the shape of nervous disorders and other ailments. If the juvenile element must chew anything, by all means let it have gum.

TEA AND COFFEE CULTURE

England is a nation of tea drinkers, with little favor given to coffee. In fact tourists claim that it is the next thing to impossible to get a good cup of coffee in Great Britain. From the English comes the retort that the same condition regarding tea prevails in America. One thing is certain, Americans know how to brew excellent coffee, and hence that beverage has become very popular with the people of the new world.

FRANCE PREFERS COFFEE.

France offers coffee as its favorite beverage, with tea and chocolate in the order named. The French also practice adulteration, with the result that in many of the big restaurants where coffee is served the taste of that article cannot be detected.

TEA THE FAVORITE OF RUSSIA.

The Russians are the greatest of all tea drinkers, obtaining their supply chiefly by caravans, into Siberia, from the Chinese provinces, where the best crop is produced. The Russian samovar, or tea-urn, is perpetually alight in every household of the empire, and tea is served not only at every meal, but to every caller between meals, and on all sorts of surprising occasions. Even a business call at a bank or office is almost certain to bring the offer of a glass of scalding tea, to be taken while the errand is explained.

Coffee culture extends over almost the whole of the tropical belt of the globe. The plant seems to bear greater climatic extremes than most members of the vegetable kingdom, and thrives in localities differing as much as thirty degrees in average temperature.

THE COFFEE TREE IN BRAZIL AND JAVA.

In Brazil, there are 16 varieties of coffee growing wild. The limit of productiveness is about 30 years. After that time, the trees may live and continue to grow, but they yield little or no fruit. In Java, coffee trees, planted nearly a hundred years ago, are said to be in existence, being now about 40 feet high, with trunks a foot in diam-

COFFEE PLANTATION.

eter; but they grow entirely wild and produce no berries. On an average, trees are replaced on the plantations every 20 years, and this process of replanting goes on constantly.

DRYING THE COFFEE.

HOW COFFEE IS GROWN.

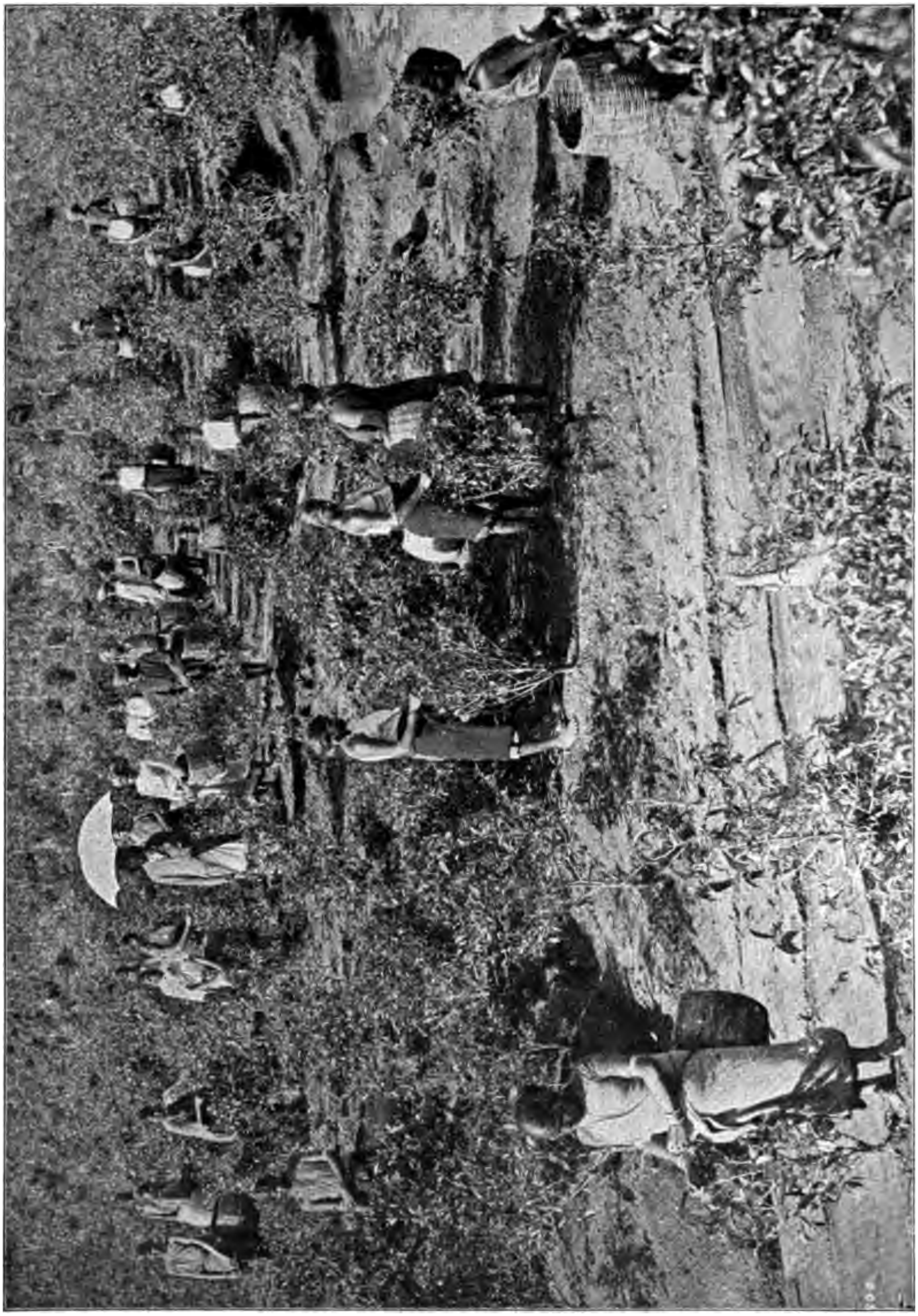
Coffee grows best on the uplands, usually on the mountain side at an elevation of from fifteen hundred to forty-five hundred feet above the level of the sea. The trees are raised from the seeds in nurseries, and transplanted when about a year or eighteen months old. The plants are usually set at intervals of eight or ten feet. They begin to bear at the age of three or four years, and when six years old, may be said to be in full bearing. Taking one year with another, a tree in full bearing produces from two to three pounds per annum. The average diameter of the trunk in full bearing trees is about the size of a man's wrist. They bear a profusion of dark-green, glossy leaves, and the fruit or berry forms on the woody stems, usually at the base of these leaves.

The berry, when ripe, is red in color, and much resembles a large cranberry. The two beans lie within, face to face, and surrounding them are five successive layers of skin and pulp, which cover and protect the beans.

TRANSPLANTING TEA.
The plant is brought from the nursery.

COFFEE PICKING.

Picking begins, in Java, in January, and lasts for three or four months. The chief part of the Ceylon crop is gathered from April to July. A small crop, chiefly of young coffee, is picked from September to December. In Brazil, they commence gathering crops in April or May, and work con-



TEA PLUCKING IN CEYLON.
The man with the umbrella owns the coolies.

TEA NURSERY SHADED BY FERNS.

tinuously until September. Women and children are largely employed in gathering the fruit, carrying it from the trees in baskets to the place where the preparation of the berries for market commences.

PULPING AND DRYING.

After the berries have been gathered, the first operation to which they are treated is called "pulping." This means to remove the outer covering of skin and pulp from the beans themselves. The berries may be treated while in the soft state, or they may be permitted to dry, after which the dried husk is removed by a machine. When this process is chosen, the berries are spread upon the drying grounds of stone, mortar or cement, where they stay until the heat of the sun prepares them for the machine. It is a similar machine, differing only in details to that which is used when the berries are to be treated in the soft state. Successive cleanings, washings and dryings finally bring the coffee into a condition for shipment to the markets, thousands of miles from the plantation where it is raised.

PRINCIPAL TEA PRODUCING COUNTRIES.

Tea in the Western Hemisphere does not figure very largely in a commercial sense, although in our own Southern states certain experiments have been made which suggests that good tea could be cultivated, even though it might not be highly profitable.

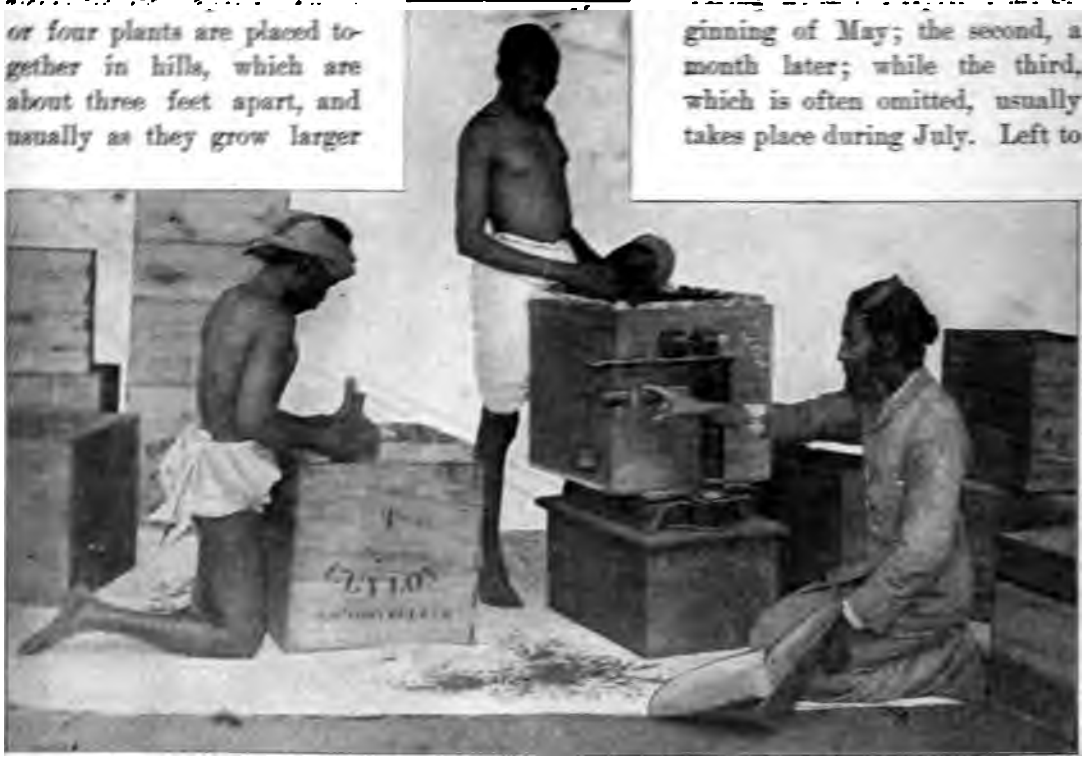
TEA CULTIVATION.

Japan, China, the Island of Formosa, India, and Ceylon are the principal tea producing countries. The tea plant is a species

HOW TEA IS POWDERED BY THE FEET.

of camellia, bearing a thick and glossy leaf, which, when green, has [illegible] There is [illegible] variety in the mode of cultivating, but the prevailing system is to plant in rows about six feet apart. Three or four plants are placed together in hills, which are about three feet apart, and usually as they grow larger

serve the double purpose of protecting them first from cold which might injure them, and later, from the sun, which tends to make the leaf tough and impair the delicacy of the flavor. The first picking, which is considered the best, takes place in Japan, during the last of April or the beginning of May; the second, a month later; while the third, which is often omitted, usually takes place during July. Left to



WEIGHING TEA CHESTS—[illegible] POUNDS EACH.

they fill nearly the whole original space left between the hills, thus making an almost continuous row. The plants are raised from the seed, and take from three to four years to mature sufficiently to yield the first crops. After that they are picked continuously for many years.

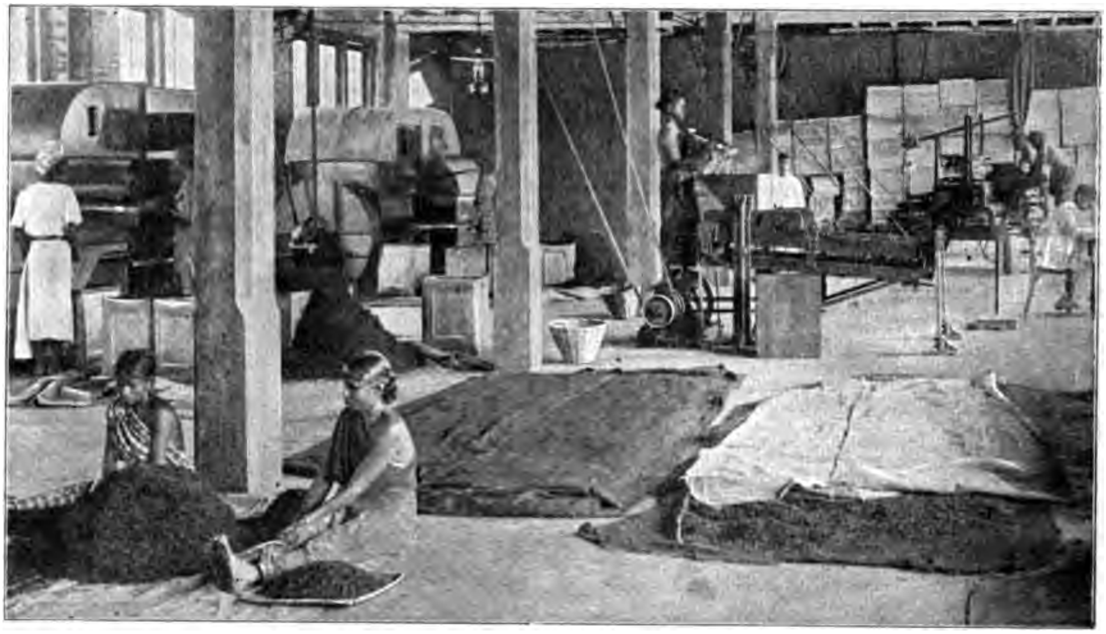
TEA PICKING.

In the districts yielding the best variety of tea, the plants are covered, during the winter and early spring, with mats, which

themselves, the plants would probably grow to a considerable height, but they are trimmed and pruned down so that they are seldom more than three or four feet high. This results in a number of small branches, producing small and tender leaves, which are the only ones sought for, although in rapid picking different sized leaves would naturally be taken, together with a considerable quantity of stems and other trash.

THE CURING AND FIRING PROCESS.

From the field, the leaves are taken to buildings for the curing processes. The flat baskets in which the tea is brought from the fields are placed over the steaming apparatus for a few seconds, the steam permeating the mass and wilting the leaves. This gives them the dark-green color, and enables the leaf to be rolled and doubled up, so that there is less liability to crumble when fired. They are then thrown upon large paper pans beneath which a gentle



INSIDE A FACTORY ROLLER—FERMENTATION TO GET RID OF USELESS ELEMENTS.

GETTING DUST OUT OF TEA.

FORCING MOISTURE FROM THE LEAVES.

coal fire is maintained. They are roasted here for several hours, during which they are constantly rolled and stirred with the hands, so as to make the leaf as compact as possible. The tea is then placed in large baskets to await the sorting process.

SORTING.

The leaves are afterwards spread out before the sorters, who with a pair of chop sticks, dexterously pick out the stems and coarse leaves, which are thrown aside as refuse. Then the rest is sifted and packed to be sent to the market.

HOW TO PRESERVE NATURAL FLOWERS

The process is a very simple one. The only articles necessary are a close box, a quantity of stick sulphur and a pan to use it in. Collect enough flowers to fill a half peck basket and then obtain a square wooden box, like those in which tea is packed.

PREPARATION OF AIR-TIGHT BOX.

Across the inside of the top of this tack two narrow strips of wood on opposite sides, upon which rest rods or strips for the bunches of flowers to hang from. The box must be air-tight; but as the burning sulphur would very quickly consume the oxygen of the air contained in it, and extinguish the fire, a hole or two must be bored, or a small door cut, in the lower part of one side. These may be closed or opened at will,—the former by means of plugs and the latter, with hinges.

SELECTION AND ARRANGEMENT OF THE FLOWERS.

Arrange the flowers in loose clusters of from two to a dozen, according to size; two dahlias, passion flowers or callas, four half-blown roses, or two or three full blown, a spray or two of fuchsias, or larkspur, pinks or lantanas, one or two camellias, a dozen forget-me-nots or lilies of the valley, mignonette and so on, according to the size. Hang each cluster, as tied, upon the rods, not touching each other. There will be room enough for about four rows. In an iron pan put a shovel partly full of clear, live coals, spreading them over the bottom, and place it on the bottom of the box.

SULPHUR FUMES.

Then sprinkle over the whole surface about two ounces of crushed sulphur and the process is begun. Leave the holes, or little door, open for a few minutes, until all progresses favorably and there is an abundance of sulphur fumes, then close the box tightly and envelop it, top and bottom, with a blanket or piece of heavy, thick carpet and leave it undisturbed for 24 hours.

THE EFFECT IN 24 HOURS.

If all has gone well the flowers will appear quite perfect in form, but bleached to a dull, creamy-white shade. This, upon exposing to a pure air in a dry place, they gradually lose, and assume their natural tints, although not so intense in shade as before the bleaching.

RETENTION OF FORM AND COLOR.

If the box has been made perfectly air-tight by sealing up all the edges, and has been kept in a dry room, the flowers thus treated, if tastefully arranged under a shade or in a recess, will retain their perfection of form and color for any length of time.

GATHERING CORK

The cork tree belongs to the class of oaks, and grows in the impenetrable forests of Spain, in the southwestern portion of France, in Algiers and in Senegambia. There are two trees, quercus suber and quercus occidentalis, that, from time to time, shed their bark or outer coating. This coating covers the cork of trade; but the bark shed by nature is not marketable, because it does not contain any sap, which is necessary to retain the elasticity.

PEELING FOR INDUSTRIAL PURPOSES.

Cork for industrial purposes is gained by peeling. After a tree is three years old, the peeling may commence; but cork of that age is of inferior quality, and the peeling would kill the tree. Trees of twenty years' growth give cork of a fair quality, improving until the tree has gained the respectable age of 100 or 150 years, when the bark becomes hard and unwieldy. Circular incisions are made around the trunk of the tree, which are connected by perpendicular cuts, allowing the two half circles to be removed. Care must be taken not to disturb the fiber, or inner bark, which keeps the tree alive.

PRESSING INTO PLATES.

The peeling process can be repeated on the same tree at intervals of from eight to ten years, yielding cork plates from one to four inches in thickness. The half round cork pieces are pressed into plates while still moist from the tree. Then the rough coatings are removed, and the plates are immersed in boiling water for several minutes and pressed again. After that they are piled in bundles, fastened by iron hoops, and are ready for the market. The raw material will sell from four to 70 cents per pound, according to the quality and thickness. The full-grown cork tree reaches a height of 70 feet, and a diameter of five feet. The quality of the cork depends very much upon the lay of the land,—that exposed to the greatest heat being the finest. Each tree yields cork of two dimensions,—the bark on the northern side of the tree being the thinnest.

The imported tree is said to thrive in some portions of the United States, but the region of the Pyrenees supplies most of the world's demand for the cork of commerce.

The tree blossoms in April or May; the fruit ripens from September to January, falling on the ground as soon as ripe. The acorns are edible, and resemble chestnuts in taste.

Cork intended for the market is generally stripped off a year or two before it would naturally come away. The cork of the first barking, which is removed usually when the tree is about twenty-five years old, is known as the virgin bark. The taking of this bark rather promotes the health of the tree. The average yield of commercial cork is about 45 pounds to one tree.

USES OF CORK.

Aside from stopping bottles and casks, cork is used for floats of nets, swimming belts, etc., and for inner soles of shoes. The waste bits are made into linoleum. The Spanish black used by painters is made by burning cork in close vessels.

ARTIFICIAL HATCHING OF CHICKENS

Although this art is not new, its present development is modern. It was practiced in Egypt as early as 1356. The heat necessary for incubation came from fermenting manure. Eggs were first hatched by the aid of fire, in 1770, by John Champion, of Berwick-on-Tweed, England. They were placed on a large round table in the center of a room through which passed two heated flues, opening into an adjoining room where the keeper sat and the coal was kept. As large a proportion of the eggs were hatched by this process as in the natural way. Few improvements were made in egg incubation from 1800 until about 1870, when the fancy for raising Asiatic and Mediterranean breeds of poultry became strong in this country, and led to the contrivance of scores of incubators. In all these the conditions aimed at were suitable heat, moisture and ventilation.

By courtesy of the Axford Incubator Co., Chicago, Ill.
THE MODERN INCUBATOR—NOTABLY A SAFETY LAMP AND A SYSTEM OF PRODUCING SUPERIOR POULTRY.

METHOD OF HEATING INCUBATOR.

The methods of heating have heretofore mainly been by warm air from a lamp, and by a tank of lamp-heated water. The eggs are carefully sorted, those laid in the latter part of the laying period being left out on account of their deficient vitality. Ordinary incubators have a capacity for 600 eggs each, but some have been made which hatch thousands at once.

TEMPERATURE FOR INCUBATION.

The heat generated varies from 102 to 104 degrees. Under the hen, the heat is rarely as much as 100 degrees until the ninth or tenth day; her temperature is from

106 to 110 degrees, but that of the eggs seldom exceeds 103°.

In order that the temperature of the eggs may reach 102°, the air in the incubator immediately over them is kept about 103° until the first half of the hatching term is reached. Then it is allowed to decrease gradually.

By courtesy of the Axford Incubator Co.
TWENTY DAYS UNDER A HEN.

TURNING THE EGGS AND ALTERING THEIR LOCATION.

The large end of the eggs, which contains the germ, is placed uppermost, and during the process the position of the eggs is ordinarily changed, and they are also turned twice a day. The period of artificial incubation is 22 days.

THE BROODER.

After the incubator comes the brooder, a contrivance heated by the same method as the former. The warmth is sometimes applied from the bottom, but generally from the side. In the brooder the incipient fowl is developed into a condition for self-support, food and water being first given from two to three days after the hatching.

By courtesy of the Axford Incubator Co., Chicago, Ill.
TWENTY DAYS IN THE INCUBATOR.

HOW CELLULOID IS MADE

Briefly defined, celluloid is a species of solidified collodion produced by dissolving gun cotton (pyroxylin) in camphor with the aid of heat and pressure.

GRINDING GUN COTTON.

The gun cotton is ground in water to a fine pulp in a machine similar to that used in grinding paper pulp. The pulp is then

subjected to powerful pressure in a perforated vessel to extract the bulk of the moisture, but still leaving it slightly moist for the next operation. This consists in thoroughly incorporating finely comminuted gum camphor with the moist gun cotton pulp. With this mixture any coloring matters required can now be embodied.

SUBJECTED TO POWERFUL PRESSURE.

The next step is to subject the mass to powerful pressure in order to expel from it the remaining traces of moisture, and incidentally to effect also the more intimate contact of the camphor with the pulp. The dried and compressed mass is next placed in a mold, open at the top, into which fits a solid plunger. A heavy hydraulic pressure is brought to bear upon the plunger, and at the same time the mixture is heated by means of a steam jacket surrounding the vessel to a temperature of about 300 degrees Fahrenheit. When the mass is taken out of the press it hardens, and so acquires the extraordinary toughness and elasticity which are the distinguishing characteristics of this remarkable production.

A SUBSTITUTE FOR IVORY AND PORCELAIN.

Celluloid is very largely useful as a substitute for ivory, which is imitated with great success. Tortoise shell, malachite, mother of pearl, coral and other costly and elegant materials are also so successfully imitated that an expert can hardly detect the original from the copy.

Celluloid is also used as a substitute for porcelain in the manufacture of dolls, which will stand a good deal of rough usage without breaking. Combined with linen it is used for shirt bosoms, cuffs and collars.

THRASHING WATERMELONS FOR SEEDS

Out in the West, where irrigation and sunshine combine to make the production of watermelons very successful, a novel industry has grown up, which is assuming huge proportions and promises a splendid revenue for the originators of the scheme.

In the upper Arkansas valley, melons are grown for their seed, and great fields are yearly covered with the luscious green shapes, destined never to tickle a palate. The melons grow to large size and great perfection. When they are fully ripe they are harvested with as much precision as are the wheat and corn crops of the plains.

THE THRASHING MACHINE.

The thrashing machine with which the melons are handled is simple. It consists chiefly of a cylinder driven by horse power or by traction engine. Great wagonloads of melons are brought to the side of the machine, and one by one they are thrown with great force into its hungry mouth, to break against the teeth below. The whole is ground to a fine pulp and run out through a sieve, the rinds being thus separated from the inner portion of the melon. The rinds are left to rot on the prairie, and the juicy mixture stands in large vats until the process of fermentation takes place, separating the seeds from the pulp. The seeds are then spread out on boards to dry and are ready for the market.

SELLING THE SEEDS.

The farmers sell the seeds to eastern firms, and in good years clear from $12 to $15 an acre for their labor. The harvest time is late in summer and in early autumn, and attracts much attention.

EFFECT OF ELECTRICITY ON MILK AND MEAT

During serious electrical disturbances in the atmosphere, it is well known that beer may become "hard," milk may go sour, and meat may frequently "turn." Considerable speculation has arisen as to the cause of this. It has been suggested that an ozonized state of the air due to electric discharge has something to do with it, or that the formation of nitrous acid in the air is responsible for the change. It is, however, not probable that the atmosphere undergoes any chemical change sufficient to account for the extent to which certain foods "turn." Moreover, any important quantity of ozone or nitrous acid would be calculated to exert a preserving effect, as both are powerful antiseptics.

It may be urged, again, that the phenomenon is due to oxidation by means of ozone, but this can hardly be the case, in view of the large quantities of beer and milk that are soured, in relation to the very small quantity of ozone which a thunderstorm produces. In the case of meat, at any rate, the "turning" can scarcely be attributed to the action of the ozone or of oxygen. The change is probably due not directly to chemical agencies, but, purely, to a disturbance of the electrical equilibrium.

THE FORCE OF INDUCTION.

It is well known that an opposite electrical state is set by induction, so that an electrical condition of the atmosphere induces a similar condition, though opposite in character, in objects on the earth. Persons near whom a flash of lightning passes, frequently experience a severe shock by induction, although no lightning touches them; and in the celebrated experiment of Galvani, he showed a skinned frog in the neighborhood of an electrical machine, which, although dead, exhibited conclusive movements every time that a spark was drawn from the conductor. In the case of milk "turning," or beer "hardening," or of meat becoming tainted, it is probably, therefore, an instance of chemical convulsion, or, it may be, of a stimulus given to bacteriological agencies set up by an opposite electric condition, induced by the disturbed electrical state of the atmosphere. Although these charges are most marked during a thunderstorm, yet, undoubtedly, they occur at other times, but not to the same degree, when there is no apparent electric disturbance.

ELECTRICAL TENSION.

But even when the sky is clear, the atmosphere may exhibit considerable electrical tension. The electroscope constantly shows that a conducting point elevated in the air is, as a rule, taking up a positive charge of electricity, the tension rising with the height of the point. This effect increases toward daybreak until it reaches a maximum some hours after sunrise. It then diminishes until it is weakest a few hours before sunset, when it again rises and attains a second maximum degree some hours after sunset, the second minimum occurring before daybreak. There are accordingly constant changes of electrical tension going on,—changes, however, which are more rapid and much more marked during a thunderstorm, and which are quite

powerful to exert an evil influence on certain articles of food or drink susceptible to change, notably, meat, milk and beer or cider.

HEADACHE, ETC., DUE TO METEOROLOGICAL DISTURBANCES.

There is no doubt that the unfavorable effects on the feelings experienced by many individuals, such as headache, oppression and nervous distress, on the advent of a thunderstorm, have a similar foundation and are due to the same electrical differences of potentiality, the effects passing away as the disturbed condition of the atmosphere changes, or the storm subsides.

ATHLETIC SPORTS OF TO-DAY

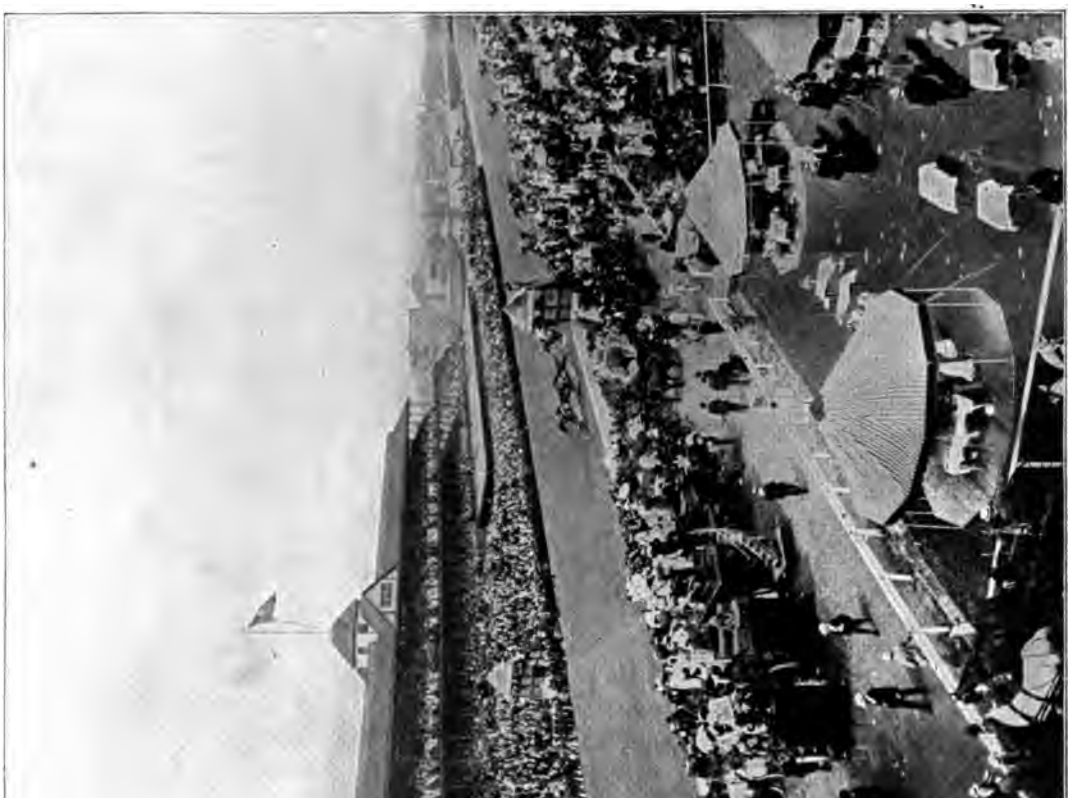
In the matter of athletic sports by which both exercise and enjoyment are obtained, America holds the lead. So important have exercises become to perfect the condition of the human body, that all colleges now maintain departments of athletics in which sports are systematically taught. Great polo, lacrosse, basket-ball, rowing, running. jumping, pole-vaulting and many other sports are very enthusiastically followed in student life.

FOOT BALL.

Foot ball is so well known that it is almost needless to describe it at length, and

FOOT BALL—CHICAGO UNIVERSITY.

rivalry is developed between the different teams of the various institutions. Probably the most popular sport in college circles of the present time is foot ball, although base ball has long been considered the national sport. Golf, of late years, has assumed a position of great prominence, and tennis, yet a few words may be said of the most complicated of the several games, Rugby foot ball. This game is played between opposing sides of eleven men each. These men fill positions as follows: Center rush, the man in the center of the "line;" right and left guard, men on either side of the



DERBY DAY—CHICAGO.

center rush, who assist him in his work; right and left tackle, men who occupy positions to the right and left of the guards, and right and left ends, who occupy positions at the ends of the line of players, and next to the tackles. Behind the line and immediately back of the center, is the quarter-back, while near him are the right and left half-backs and behind them all the full back.

Two elevens are drawn up face to face. One of the teams, by toss-up, has secured the ball, an oval-shaped affair, of pig's skin, which encloses an inflated rubber bag. The object of the play is by a series of kicks, punts, rushes, or runs with the ball, to send it from the center of the foot ball field to the enemy's goal line. At the opposite ends of the field are sets of two high poles crossed by a central bar. These are the goal posts. When occasion presents, the ball may be kicked over this goal, thus making a score, but more generally the play is for a touchdown, that is, carrying the ball over the enemy's line and touching it down in that territory.

Numerous trick plays and formations are used to send the ball from one end of the field to the other. The play is very rough at times, because of the scrambling to prevent the ball from being put in motion. To avoid danger, the players pad their clothing and use great head guards and shin guards of leather, and nose guards of rubber. Every year many players are seriously injured at the sport, and many people decry it as brutal. The players themselves, however, its most ardent supporters, maintain it is a grand, healthful and not necessarily dangerous game. Great rivalry exists between the teams of the great universities and colleges. The great foot ball day of the year is "Thanksgiving day," when every college team in the land plays great and exciting games.

BASE BALL.

What person does not know base ball? The smallest urchin seems born to a knowledge of tossing and batting a ball. The national game is still so popular that several leagues, of many clubs each, are given good support in their public performances throughout the summer and fall months.

STEEPLE CHASE.

GOLF.

Golf has been the craze in fashionable circles of late years. This game consists of knocking a small gutta percha ball across specially prepared fields, called links. The course of the field is arranged with a number of holes at greater or less distances from each other. The player, using one of a set of numerous kinds of specially prepared clubs, drives the ball from hole to hole, the one who covers the course in the fewest

THE FAVORITE GAME TO-DAY.

SURF BATHING—NEW JERSEY.

number of strikes, winning. In order to make the sport more exacting, hazards are interposed on the links. Huge banks of earth and grass called bunkers, ponds of water, and other hindrances so that where the ball will have to be driven far and swiftly, make up these hazards.

CURLING.

A POPULAR WINTER SPORT.

Ice Boats in a "Northeaster" on the Hudson River.

The history of this pastime dates back to the 18th century, when Oliver Booth built the first yacht of this character at Poughkeepsie, New York. In many respects the study of models is fully as interesting as that of the sea boats, and one can easily understand its fascination when comparing the speed of water craft with the ice boat—a comparison making the former seem like an anchored scow, for records show that the fast express trains are often beaten by the ice yachts in a stiff gale.

BASKET BALL.

Basket ball is a great indoor sport, played principally during the winter months. The game is to drive a large inflated ball by throwing and bouncing to the enemy's goal, which consists of a sort of basket suspended about nine feet in the air.

This game is often very exciting and nearly every college and athletic association has a team. The game is very popular in women's colleges, which have teams of great merit.

WATER SPORTS.

Water sports continue to be followed by athletes who live near bodies of water. The great Henley sculling matches on the Thames

river, of late years, have been participated in by American college teams, with victory frequently perching on the American banners. Swimming also is in great vogue, and many great contests are held in different places for speed and distance. Water polo is a near adjunct of swimming. This game is played like ordinary polo, save that the ball is carried to the goal by men swimming in the water.

UNCLE SAM'S "SPECIAL DELIVERY" BOY

Almost everybody has seen the gray-uniformed messenger boys employed by the United States Post Office Department. Although it is not generally known, they are beset by the same trials and tribulations regarding wages, which vex those holding similar positions with business corporations.

WAGES OF THE BOYS.

Thirty dollars a month is all one of Uncle Sam's special delivery boys can earn, and this he must accumulate at the rate of eight cents for each letter delivered. Take, for instance, the Chicago post office.

THEIR AGES.

In that office the ages of the boys range from 14 to 19 years, the average being about 16. No examination is required to enter the service beyond the usual questions pertaining to character, etc. After a boy reaches the age of 18 he is permitted to take the examination for clerk, and scores of them are now filling such positions after having passed through the special delivery service. About 15 per cent of the boys employed at present are colored.

RULES GOVERNING THEIR WORK.

They are governed by a military sounding set of rules, and it is expected of them that while on duty their conduct and manners shall be above reproach. The suspension system is employed for cases of derelictions, which are not serious enough to call for discharge. The training is considered excellent, especially by business men, by whom many of the boys are employed after they serve their apprenticeship with the government. Several former messenger boys are now holding responsible positions in banks, others still are working for the government in more lucrative positions, while a great many special delivery boys are to be found in most of the large wholesale and retail houses of the downtown district. The opportunity for making valuable friends is great, and where a boy takes advantage of it he is apt to profit.

NUMBER OF BOYS AND THEIR DELIVERIES MONTHLY.

Forty-five thousand special delivery letters are distributed over 190 square miles of Chicago territory every month. Twenty-five thousand of these go through the stations and substations located in different parts of the city, and the remaining 20,000 are sent out direct from the postoffice. The rapid distribution of this bulk of important mail rests largely with 144 boys, who wear the caps and uniforms of the special delivery department. The work of these messengers makes it possible for the government to deliver a specially stamped letter to an address four miles from the postoffice within forty minutes after it has been received,

and they are responsible in a large measure for the success of the department.

AREA COVERED AND METHOD OF WORK.

The government arranges that no messenger shall work more than his allotted amount. Thus a sufficient number of boys is employed to keep the aggregate returns from the special delivery service adequately distributed. These messengers work in shifts from 7 a. m. to 11 p. m. One shift is on duty until 3 o'clock and another handles the letters until the hour of closing at night. Whenever it is convenient or there is any chance of saving time, special delivery letters are sent out to substations, to be conveyed to their destinations from that point. At 4 o'clock the last dispatch to outlying stations is sent out. At 5 o'clock another leaves the postoffice for more centrally located points. Then between 5 and 6 o'clock the entire city is covered by messengers. After 6 o'clock the delivery boys cover seventy-five square miles, and at 9 o'clock the aggregate territory is reduced to twelve square miles. Between 6 and 11 p. m. there are but thirty-five messengers on duty, and on an ordinary night they handle 350 letters. On Saturday night the number is increased to about 500.

It makes no difference what the condition of the weather may be, these youngsters must deliver letters to any address as late as 11 o'clock. Within a radius of ten miles they are expected to use bicycles for transportation purposes, one of the requirements for entering the service being that a boy shall own a bicycle in good condition and a full uniform, costing $12.

DELIVER 1,000 LETTERS A DAY.

With more than 1,000 letters a day bearing special delivery stamps coming into the postoffice, it would be impossible to handle them if each boy were given but one on a trip. The result is that when a boy starts out he may have two, three or half a dozen letters to deliver and may make as much as 50 cents by traveling but a few blocks. But the aim of those in charge of the department is to make the earning capacity of one boy no greater than that of another, and they endeavor to regulate distances as best they can.

Most special delivery letters are carried on bicycles, but in cases of extremely severe or unpleasant weather the boys are furnished with money for car fare on lines which do not recognize the government's messengers to the extent of giving them free transportation privileges. Thus in an average day's work a boy will ride many miles on his bicycle, and also take several lengthy jaunts on steam or street cars.

The "first in first out" system is followed in the postoffice in sending out messengers. Each boy is supplied with a paddle bearing his number. When he comes in from a trip he surrenders this to the man in charge, and it is placed on the bottom of a pile representing the boys who are in ahead of him. As soon as there is a letter to deliver the clerk takes a paddle from the top and calls the number printed on it. In this way the trips are kept straight and no one boy has an advantage over another.

BATHING FOR HEALTH AND BEAUTY

Hardly anything is more beneficial to the human body than the right kind of a bath at the right time. There are at least a dozen different kinds of baths, and there are conditions of the body when eleven of them may be either of doubtful benefit or positive injury.

HOT BATH FOR CLEANLINESS, COLD BATH FOR TONIC.

Many persons who are physically strong and of regular habits go through life healthfully, taking just two kinds of baths—the hot bath at night for cleanliness and the cold morning plunge for a tonic. Such persons need no advice about bathing.

In the case of children and the majority of adults the other eight or ten varieties of bath should be thoroughly understood. There is hardly any remedial agent so speedy and favorable in its action as the cold, tepid, warm, hot, plunge, shower, sponge, pack, foot, or sitz bath intelligently applied.

TEMPERATURE OF THE BATH.

It is mainly a question of temperature—temperature of the body and temperature of the bath. When the temperature of the body is normal and the general health is good, one may safely suit his fancy in the matter of baths, provided he keeps his skin clean and the pores unclogged. Most people know that a cold plunge is injurious only when it overtaxes the resisting power of the bather so that exhilarating reaction does not follow the otherwise beneficial shock. Anyone, however, healthy and strong, may remain in cold water so long that fatigue and even severe prostration result.

THE SHOWER BATH..

Respecting the shower bath, the douche and other baths in which the nude body is exposed to currents of water, there seems to be much popular misinformation. All these baths are exaggerations of the cold plunge and should be used with caution.

THE HOT AND WARM BATHS.

The warm bath is relaxing, as there is no reaction. If prolonged it is enervating, and the same is true of the hot bath. A bath of a temperature above 110 degrees can be borne only a short time without injuriously exciting the heart.

CHILDREN'S BATHS.

Systematic cold bathing is frequently beneficial to children who have a sluggish circulation, with a poor appetite and feeble digestion and who are addicted to colds, but these baths should not be showers or douches except when prescribed in specific instances by a physician. There will be sufficient shock and tonic effect if the child is sponged with cool water in a warm room for not more than five minutes at a time and then dried and gently rubbed.

For children warm baths are valuable to bring blood to the surface when there are spasms, colic or congestion of some inner organ. If there is congestion in the brain, indicated by headache, warm or hot bathing of the extremities of the body will tend to relieve the pain and promote sleep.

When the temperature of the body is

normal, hot or cold baths will neither heighten nor lower it. But when the temperature is abnormally high—when there is fever—it may be brought back toward the normal point by cold bathing. In the absence of medical advice, however, such treatment should be limited to a sponging of the entire body in water whose temperature is not lower than 70 degrees.

THE COLD PACK.

The cold pack is more efficacious in cases of fever than cold sponging, but unless ordered by a physician it should be used seldom, and then with caution. A folded sheet is dipped in water not colder than 85 degrees, and in this the body is wrapped from armpits to ankles, with a blanket for outer covering, and then left undisturbed for ten minutes. Then the patient is taken out of the wet sheet and enveloped in a blanket and allowed to remain quiet.

THE TEPID BATH.

In bathing children no mistake is made in using the tepid bath, of about 95 degrees, which, after the child has been placed in it, may be cooled down to 90 or 85 degrees. On being taken from the bath the child should not be dressed at once, but wrapped in a bath blanket and left there for twenty minutes. This will prevent chilling.

Proper bathing, according to the condition of the body, is almost a fine art, and its value is so great as to make that art well worth intelligent study.

OUR SCHOOLBOY SOLDIERS

The American boy may or may not be a born soldier, but it is certainly true that he is being made into one on a large scale. Most of our privately endowed schools for boys throughout the United States include more or less of military life and discipline in their daily routine, and the system is steadily growing.

NUMBER OF MILITARY INSTITUTES FOR JUVENILES.

At present there are about 60 public and chartered military schools in this country, and more than 100 private institutions of this kind. Some of the school military corps have actually become miniature armies, proficient in the tactics of every branch of the service.

MINIATURE MILITARY POSTS.

Their headquarters are military posts, where the stars and stripes are raised at the boom of the sunrise gun. From the day when he dons his uniform until the final inspection at graduation time, the boy who goes to a military school leads a life of soldierly discipline. He learns the vocabulary of the army. He has his quarters in the barracks. He eats in a "mess-hall." The drum-beat displaces the morning bell, and "reveille" is the rising signal. "Tattoo" warns him to prepare for the night, and at "taps" the day's routine is officially closed.

THE CADET'S FIRST LESSON.

The cadet's first lesson is how to carry himself, and he spends many hours in the awkward squad before he stands "toes out," "head up" and "eyes front" to the satisfaction of the drill corporal. His fatigue and dress suits are made to fit without a wrinkle, and he must wear them so. His cap must be cocked at a right angle. His room

is regularly inspected, and any untidiness means a demerit mark in his superior's report.

THE MANUAL OF ARMS.

Taught how to stand, how to walk and how to wear his clothing, he goes into another awkward squad to learn the manual of arms. Then, after he has got a number he is ready for real work. He is then required to spend two hours each day in drilling.

HEALTH AND MUSCLE

Well-developed men are to be envied. They invariably enjoy splendid health. There are many ways of exercise which do much to make the physically perfect man.

Too often the abdominal muscles are neglected or exercised only perfunctorily. As a result, the blood in the abdominal region becomes sluggish, for blood does not flow with health-giving quickness unless it receives aid from working muscles. Muscles that are dormant retard the blood's flow, and slowly moving blood does not properly purify the body. Therefore, when the blood in the abdominal region becomes sluggish, indigestion, constipation, biliousness and other and more serious abdominal complications are the result.

All of these ailments are more or less pronounced demands of the abdomen on its possessor to take proper care of it, and proper care means nothing more nor less than a few minutes' exercise of the abdominal muscles after getting up mornings, and before going to bed. The man who will give attention to his abdomen will be amply rewarded. Instead of suffering from indigestion, he will be blessed with a digestion that will compare favorably with that of an ostrich. He will forget what stomachache is like, his liver will refuse to make him bilious, and, in short, all the organs in the lower half of the trunk will perform their functions happily, as nature intended.

Then, too, sturdy abdominal muscles contribute largely to the correct carriage of the body. If these muscles are not strong, the abdomen cannot be held in, and a protruding abdomen has a marked tendency to cave in the chest and twist the spine out of shape. In brief, a man who permits his abdomen to protrude, cannot stand erect, no matter how hard and long he may try. Every sane person admits that proper poise is absolutely and unequivocally necessary to good health; therefore, every well-balanced mind cannot disregard the necessity that the abdominal muscles, so necessary for correct carriage, should be sedulously exercised.

Healthy abdominal muscles also help to develop the chest. When breathing, the further one can pull in the abdomen the greater will be the lung expansion. The stronger the abdominal muscles, the further in goes the stomach, the lungs drink in greater quantities of fresh air, and the blood is furnished with enlarged supplies of purifying oxygen. And everyone knows what oxygen does when it gets into the human system.

A man who exercises his abdominal muscles need not fear that, as he gets along in life, he will annex a "bay window." Fat cannot accumulate in this region if daily exercise is indulged in. On the other hand, exercise will remove fat and restore to men

with abnormal abdomens their natural outlines and proportions.

Again, strong abdominal muscles are the best and safest protection against unexpected blows "below the belt." And last, but by no means least, he who gives diligent concern to the muscles under consideration will not become nervous under business stress or from other causes.

EXERCISE I.

Starting with the correct standing position, head up, shoulders back, chest out, abdomen in, arms straight and at the sides of the body, knees and heels touching and toes at an angle of 60 degrees, grasp the left hand with the right, interlocking thumbs and placing the left fingers above the right. Raise the arms above the head, and while doing the exercise, keep them continually by the sides of the head. Bend the body at the hips and endeavor to reach the floor with the fingers. Exhale as you go down, inhale deeply as you come up slowly, and bend back as far as possible. Repeat until tired, then take up another exercise. As the body is bent downward, the lower front muscles of the abdomen and the muscles of the back are developed. As the body is bent backward, the muscles of the back of the abdomen are brought into play.

EXERCISE II.

Raise the arms over the head as before. Turn the upper part of the body noticeably to the right, and then bend the upper part of the body sidewise and down as low as possible. Alternate by doing this exercise to the left. The muscles in the sides of the abdomen are thus developed.

EXERCISE III.

This exercise is splendid for the solar plexus and the upper part of the abdomen. It quiets the nerves and strengthens the diaphragm and its muscles. Lie down on your back on the floor, bend the legs at the knees and draw them up, getting the heels as close to the hips as possible. Fold the arms over the chest, and then raise the head, shoulders and chest from the floor as high as you possibly can, striving hard and ever harder. When at the highest point, hold them thus for a moment, and then lie down and repeat.

EXERCISE IV.

Lie flat on your back on the floor. Put the hands flat under the hips and have the whole upper part of the body relaxed. Then kick with one leg as high as possible and then kick with the other. Alternately kick the legs, keeping both off the floor, and kick rapidly. Be sure to keep the legs straight When the legs descend from the highest point toward the floor, they should stop about six inches above the floor. This exercise is unexcelled for the muscles in the central and lower portions of the abdomen.

TWO SPLENDID EXERCISES.

And now for two splendid exercises that will prevent varicose veins and build up legs capable of properly carrying the body. Sturdy legs are as necessary to a body as flawless wheels to a locomotive. Don't neglect your legs and thereby put yourself in the way of dangers that may wreck both your legs and your good health.

No. 1—Assume the correct standing position. Relax the legs below the knees. Then alternately and rapidly, with the leg ascending, bent at the knee, kick the knee up toward the chest, keeping the lower part of the leg well forward. Try hard to hit the knees against the chest. This exercise is beneficial for the so-called kicking muscles, the muscles of the upper leg and thigh.

No. 2—This is excellent for the lower part of the upper leg. Start from the correct standing position. Grasp a stick in the hands, and keep the arms straight and well in front of the body. With the knees and heels together and heels and toes touching the floor, sit down as low as you can. Do this part of the exercise as quickly as you like, but rise up slowly, keeping the upper part of the body erect, as in the correct standing position.

A GENERAL EXERCISER.

For a general exerciser of the entire front of the body—legs, abdomen, chest, arms, wrists and shoulders—lie flat on the abdomen, on the floor, *face down*. Be sure that the body is perfectly straight, the toes touching the floor and the feet close together. Then, with the palms of the hands flat on the floor and the elbows at the sides of the body, fully straighten the arms, and support the body on hands and toes. The body must not be permitted to bend; keep it solid and straight. Hold it thus for a moment, and then bend the arms and let the chest touch the floor. Repeat this until tired.

These exercises, like many others, do much to make the physically perfect man and maintain general good health.

The foregoing observations and instructions are from the pen of Prof. Hamlin Barber, of Boston, Massachusetts.

LIME IN AGRICULTURE

The effects of lime, when applied to the soil, are partly mechanical and partly chemical. Upon deep alluvial clay soil it increases the crop of potatoes and renders them less waxy. Sprinkled over potatoes in a store heap it preserves them, and when scattered over the cut sets, it wonderfully increases their fertility.

ERADICATES DISEASE IN TURNIPS.

Lime eradicates the finger and toe disease in turnips, and gives greater soundness to the bulbs. It gives when applied to meadow lands a larger produce of more nutritious grasses. It also exterminates coarse and sour grasses, destroys couch grass and acts powerfully upon rye grasses. Upon arable land it destroys weeds of various kinds.

DECOMPOSES VEGETABLE MATTER AND PRODUCES CARBONIC ACID GAS.

It rapidly decomposes vegetable matter, producing a large amount of food for plants in the shape of carbonic acid gas. It destroys or neutralizes the acids in the soils: hence its adaptability to sour soils. It acts powerfully upon some of the inorganic parts of the soil, especially on the sulphate of iron found in pasty soils, and the sulphate of magnesia and alumina.

IS FATAL TO WORMS, SLUGS AND DANGEROUS LARVAE.

It proves fatal to worms and slugs and the larvae of injurious insects, though favorable to the growth of shell bearers.

SLAKED LIME FREES NITROGEN FROM VEGETABLE MATTER AND FEEDS PLANTS WITH AMMONIA.

Slaked lime added to vegetable matter causes it to give off its nitrogen in the form of ammonia. Upon soils in which ammonia is combined with acids, it sets free the ammonia, which is seized upon by the plants. Its solubility in water causes it to sink into and ameliorate the subsoil.

DECOMPOSES GRANITE FRAGMENTS, OR TRAP ROCKS IN THE SOIL.

When the soil contains fragments of granite or trap rocks, lime hastens their decomposition and liberates the silicates.

PRODUCES POTASH AND SODA IN THE SOIL.

Its combination with the acids in the soil produces saline compounds, such as potash and soda, etc. Strewn over plants, it destroys or drives away the turnip fly. Worked in with grass feeds, the beneficial effects of lime, chalk, marl and shell sand have long been visible.

DESTROYS THE SEEDS OF WEEDS.

Applied to the rot heap, lime effectually destroys the seeds of weeds.

IN THE MINE WITH THE MINER

A HAZARDOUS OCCUPATION.

The life of the American miner is one of hazardous undertaking and constant danger. When he bids his wife and children good-bye in the morning or at night, or whenever he starts for the mine, he knows not whether he shall ever see them again.

INADEQUATE WAGES.

The miner of the average mine is overworked and underpaid. The miner in the bituminous coal fields is paid from 20 to 40 per cent higher wages than those doing similar work in the anthracite fields. The fact is that the minimum wage received by any class of adult mine workers in the soft coal mines is 26 1-4 cents per hour, while the minimum wage paid to boys is 12 1-2 cents per hour. In the anthracite coal mines, men performing precisely the same labor receive from 13 to 20 cents per hour, while boys are paid as low as 5 cents per hour, and rarely receive more than 8 cents per hour. The bituminous miner works a maximum of eight hours per day, which is two hours less than the men in the anthracite mines are required to work. Moreover, the anthracite mine worker labors under the further disadvantage of being more liable to be killed or injured, the casualties being 50 per cent greater in anthracite than in the bituminous mines.

AMOUNT MINED BY EACH MINER IN 1897, 1898, 1899 AND 1901.

The average miner, whether he be in the anthracite or bituminous coal mine, is a hard worker. Statistics for the year 1897 show that 1,271 tons were mined by each miner, with an increase of 22 tons for 1898 and 98 tons for 1899. The increase was steady until 1901, when the average man mined 1,585 tons of coal.

For this amount of coal the miner is paid in the neighborhood of $1.85 per day, or for the number of working days in 1901, $368 per employe, or an average of $7.05 per week. Divide this among a family of from three to six people and what is the result? Poorly clad children and empty stomachs about two-thirds of the time.

THE MINER'S HOME, CLOTHING AND FOOD.

The miner who is thus paid is compelled to live in small, squalid hovels, which, in many instances, have but two rooms, and not infrequently but one large room, in

which are housed a family of six or seven people. The clothing worn by these miners and their families is of the poorest quality imaginable, and very coarse. Their food consists of corn bread, with pork and corned beef for meat. Butter is never heard of, and the poorest grade of oleomargarine is used by them.

THE "BREAKERBOY."

The "breakerboy" is the stepping stone to a full-fledged miner. Hardly has the boy reached the age of nine years before he is set to work in the big "breakers." This is made necessary by the large families and the cost of living. The average wages paid the "breakerboy" will not exceed 60 cents per day, and are frequently less.

The number of days lost by the miners during 1902, when a strike was on, was 20,000,000, as compared with 733,802 in 1901, 4,878,102 in 1900, and 2,124,154 in 1899. The value of the output of coal for 1902 was in the neighborhood of $348,910,-469.

The foregoing article is the expression of John Mitchell, president of the United Mine Workers of America.

A DAY ON THE FARM WITH THE FARMER

The economical and successful management of a 160-acre tract of farming land requires less business ability than manual labor, but to conduct upon a paying basis are numerous farm ranches of large extent, whose owners are modern captains of industry. These men are solving problems and carrying on enterprises upon their

CRADLING GRAIN.
The method of harvesting prior to the invention of the reaper.

farms containing several thousand acres, the requirement is changed from muscular power to brain work. In the middle west farms worthy of the brains of great trust builders. And in many instances their income is quite as large. Those who have

spent a lifetime in one community in trying to get a fortune out of soil-tilling would be astonished at the magnitude of farming upon the plains of the southwest.

AVERAGE SIZE OF FARMS IN THE UNITED STATES.

The average size of each of the five million farms in the United States is 146 acres. This small average is due to the 160-acre and 80-acre farms in New England and the south.

region west of the Missouri river is no more like its predecessor, the ranch of a score of years ago, than is it similar to an old New England homestead. But the principal difference is in the management. The west is rapidly filling in with homeseekers, who are in turn taking all the government lands open for homestead entry. Indian reservations, formerly nothing but vast cattle ranches, are being thrown open to white settlement.

By courtesy of the McCormick Division, International Harvester Co.
WHEAT IN THE STACK.

AVERAGE SIZE OF FARMS IN THE SOUTHWEST.

In the western division there are larger farms than in any other portion of the United States, the average size being 1,000 acres in Oklahoma, western Kansas and Texas. In the Indian Territory the average size of each Indian's holdings is 500 acres. The western division also shows a larger increase in the prices of land than in any other section.

NEW METHODS OF FARM AND RANCH MANAGEMENT.

Farming and ranching have changed greatly within recent years. The modern farm in Kansas, Oklahoma or any prairie

FARMS BELONGING TO INDIANS.

The Indians are given farms of their own and told to go to work. Fifteen thousand Indians were placed on their individual allotments in 1901, and 1,300 farms were given away to white settlers. This rapid settlement of the West means a concentration of farming and ranching interests. The 1,000-acre farms are not being reduced in acreage, but are being turned over to expert managers.

In the eastern and middle west states the farmer of to-day has anywhere from 100 to 300 acres of land under cultivation. To spend a day on an American farm is to learn much about where the enormous pro-

duct comes from which goes to feed the 80,000,000 inhabitants of the United States, in addition to furnishing a considerable part of the food product for the use of foreign nations.

AVERAGE AMERICAN FARMER IN EASY CIRCUMSTANCES.

The American farmer of to-day, while in many instances not wealthy, is still comfortably well off, and does not have to worry about where the next meal is coming from. He has a few cattle, owns several horses, and can go to town with as fine a turnout as any man of moderate means would desire.

The farmer is quite an independent person, and when his work is done for the day, he goes into the house, gets out his country paper and enjoys its contents for an hour or two, smokes his pipe, and when it is time, goes to bed. In the morning he rises early, cares for his stock before breakfast, and when daylight comes, goes forth to work.

WAGES OF FARM LABORERS.

There was a time when the wages of the farm laborer were considerably more than they are at present. In olden days farm hands were paid $30 and $40 per month and "found." To-day the wages average from $20 to $30, although in many of the western states, during harvest time, the pay for a short period ranges from $2 to $2.50 per day.

TO-DAY'S METHODS OF FARMING.

The farmer of to-day uses all of the modern methods which a few years ago were unknown. He has the latest style of threshing machine; his crops are cut by machinery, and, in fact, it has almost come to pass that his stock is fed by machinery.

IMPROVEMENT IN ROADS.

Roads that in former years were made by hand are to-day "cut" and "graded" by machinery, and so quickly is the work done that really bad roads are fast passing out of mind.

IMPROVEMENT IN MAIL AND TELEPHONE FACILITIES.

Another innovation, the rural mail route service, enables the farmer to have his mail delivered at his house once or twice a day. The farming districts have also been connected with the city by telephone, which brings the American farmer in touch with all the world. These changes are doing much toward keeping the young men upon the farm instead of flocking to the city.

BUGS COSTLIER THAN BATTLESHIPS

HOW "UNCLE SAM" LOSES $358,000,000 EVERY YEAR BY INSECT PLAGUES THAT INFEST HIS GROWING CROPS.

The magnificent warships constructed within the last decade by the United States government and designed to protect our flag against enemies from without, have imposed an enormous burden of expense upon the nation. But our people are ever confronted by insidious foes within, which inflict upon the agricultural interests of the country losses aggregating far more in a single year than the cost of all the battle-

ships built by "Uncle Sam" from time immemorial. These foes and these losses are thus specified:

Cabbage worm	$ 5,000,000
Potato bug	8,000,000
San Jose scale	10,000,000
Grain weevil	10,000,000
Apple worm	10,000,000
Cotton worm	15,000,000
Army worm	15,000,000
Boll weevil (cotton)	20,000,000
Boll worm (cotton)	25,000,000
Hessian fly	50,000,000
Grasshopper	90,000,000
Chinch bug	100,000,000
Total	$358,000,000

A DAY WITH THE STOKER ON SHIP-BOARD

The man who feeds the furnace of the marine boiler is summoned to his task at eight bells.

A SLAVE OF THE TOWERING BOILERS.

Hurriedly donning his working outfit, he descends many rungs of iron ladders until he reaches an iron platform on the bottom of the hold, where for four hours he must strive as the slave of the two or three towering boilers in front of him. Above him, through a circular opening, comes a current of fresh air, sent down by the big ventilator on deck.

FEEDING THE ROARING FURNACE.

With feet stretched wide apart on the sloppy platform, he seizes a shovel and throws wide open the doors of the roaring furnaces in turn, the vessel sometimes pitching violently. With tense muscles and a desperate sort of energy, he shovels in coal in great quantities, and occasionally rakes the surface of his fires. At intervals he pokes them with "slice" and "devil" to prevent clogging of the bars, until the furnaces are in a fierce, white glow.

CLEANING THE FIRES.

When the stoker finds it necessary to "clean the fires," he throws open the door of one furnace, while the others, at their utmost blast, are supplying the needed motive power. Laboriously working his "slice" and "devil" into the innermost vitals of the raging mass, he pulls out a quantity of clinkers, blistering hot. This he at once dampens, causing a choking smoke. After repeating the process several times, until the furnace bars are clear of obstruction and the upward draught is perfect, he replenishes the somewhat enfeebled fire with more fuel, and applies himself to the other furnaces likewise.

All this requires incessant and intense exertion in the face of roasting heat, and involves an exhaustive strain upon the stoker. Instances have occurred in tropical climates where he was totally unable, when relieved, to climb on deck, but fell on the reeking floor, limp as a heap of wet rags.

A DOUBLE RELIEF AND EXTRA RATION.

On account of the severe requirements of his task the stoker has eight hours off, instead of the four hours which compose the sailors' relief period. It is not uncommon, also, for him to be favored with a better ration than the sailors get, in the shape of a mess from the galley called the "black

pot," composed of remnants from the saloon passengers' fare.

THE COAL BUNKERS AND THE "TRIMMER."

The coal supply of the ship is stored in high bunkers, with water-tight doors opening into the stokehole. Out of these magazines the trimmer, also under a fearful strain, throws the coal to a point convenient for the stoker. Although not exposed to fiery heat, he has no cooling air-current from overhead, but must work in a close place, and with the aid of a safety lamp.

COAL CONSUMED ON A SINGLE PASSAGE.

Some ships use 3,000 tons of coal in a single passage, consuming from 20 to 30 tons per hour.

A DAY WITH THE BRAKEMAN ON THE TRAIN

On every freight train are two or more brakemen. The disagreeable features of their experience result mainly from severe weather, although they have much trouble with tramps.

THE FREIGHT BRAKEMAN MUST BE "ON TOP."

In running on ascending grades or at a slow speed, the brakeman can ride under cover, but in descending grades or when running fast, he must be on top, ready to apply the brakes instantly.

THE RED FLAG.

When a train is unexpectedly stopped on the road, the rear-end brakeman takes his red flag or lantern and hurries back half a mile to give the stop signal to any train which may be following.

COUPLING THE CARS.

Another duty of the brakeman is to couple the cars, the uncoupling being generally devolved on the freight conductors. Both these tasks are dangerous and result in the loss of many lives.

ASSEMBLING AND CHANGING THE CARS.

The brakeman is on hand promptly at the hour of preparation for departure, and has a brief period of lively work in assembling the cars from different tracks, changing cars from the front to the rear or middle of the train, and setting aside those that are broken or disabled.

GETS GOOD THINGS TO EAT.

During much of his trip-time in the pleasant months of the year, the freight brakeman has an opportunity to get acquainted with the farmers, from whom he buys good things at low prices and lives on fine fruits, vegetables, etc.

THE PASSENGER BRAKEMAN.

The passenger brakeman has to deal more or less with the public, and his chief duties are those of a porter. On the modern "limited" trains his day's work consists of a three hours' run without stop.

FLAGGING AND FLIRTING.

Occasionally the passenger brakeman must go back to "flag." In former days he was credited with much flirting along the run, and he has not altogether outgrown it. If he does well he will become a conductor.

A DAY IN THE CIGAR FACTORY

Havana and Manila tobaccos only are used exclusively for cigars, although great quantities raised elsewhere are devoted to this purpose.

BEGINNING AND DEVELOPMENT OF THE MANUFACTURE.

The manufacture of cigars in the United States began in a small way in 1801; the first factory was built nine years later. Before the civil war this country produced less than 200,000,000 cigars; in 1875, 2,000,000,000; in 1892, 4,500,000,000.

MACHINES FOR CIGAR MAKING.

In America machinery is used for manufacturing cigars wherever possible, and the molds for shaping them are made of hard wood, sometimes partially lined with tin, and of every conceivable size and form.

TYPICAL SCENE IN A CIGAR FACTORY.

PROCESS OF MAKING CIGARS BY HAND.

Cigars are composed of three parts, the cone, or filler, the binder and the wrapper. All of the very best cigars are probably made by hand. The maker rolls together, somewhat loosely, pieces of leaf placed longitudinally, and on this he places the binder, around which he carefully winds the wrapper.

THE CIGARMAKER'S TOOLS.

The only tools used by the cigarmaker are a short-bladed sharp knife, a vessel containing an emulsion of gum, and a square wooden disk, or cutting board. The maker, after molding his bunch of fillers inside the binder, shapes a portion of perfect leaf to form the wrapper. When he has rolled this around the binder he deftly trims the thick end with his knife, secures the taper end by gumming and the cigar is ready for sorting and packing.

TYING UP CIGARS.

SORTING THE GOOD TOBACCO FROM THE POOR.

A DAY WITH THE CHAUFFEUR

Good chauffeurs are at a premium. They can name their own salaries and almost regulate the hours they desire to work. The salaries of good chauffeurs run from $40 to $150 a month, which includes "find."

ABOVE THE COACHMAN.

The position of the chauffeur is a pleasant one. He is so many degrees above the average coachman in the social scale that he is not to be considered in the same category. The coachman may become a chauffeur, but it is not likely that the chauffeur ever will take the coachman's place.

QUALIFICATIONS FOR THE WORK.

The position of chauffeur is one young men will find worth having. Their salaries depend upon their abilities. It does not require a machinist to operate an automobile, but the man who undertakes it must be practical. He must understand every piece of machinery connected with it, so that when anything goes wrong, he can determine, by a quick examination, where the break has occurred. Then he can apply the necessary remedies and proceed as if nothing had happened. The position of chauffeur at present is largely that of an "extra engineer," when his employer is along. He sits beside the driver and watches him operate the brake, and when anything happens, leaves his place to make the required examination.

PROMOTIONS IN AUTOMOBILE FACTORIES.

There are scores of positions awaiting the bright, active young man in the agencies of the automobile factories, where by close application to work he can push himself into a foremost place.

In one of the agencies in Chicago is a young colored man, a graduate of an eastern college and of a pharmaceutical institute, who concluded he wanted to try something more enticing than mixing drugs. He entered the local agency at $12 per week, studied the machines for six months with an energy that soon made him their master, and was advanced steadily until he is now getting $80 per month, in a position where work is a pleasure.

CHAUFFEUR MUST BE A YOUNG MAN.

The chauffeur, to be successful, must be a young man; not too young, or he will lack discretion, but young enough to guarantee that every effort he makes will be felt, and that his employer will know he intends to make the business his for life. In the agencies he is employed to watch over the machines, much as a mechanic goes over the parts of an engine. Whenever a purchaser calls, he may be sent out to "show off" the machine.

CLERK SELLING THE MACHINE IS HIRED TO RUN IT.

This occurs occasionally, but may happen a dozen times a day. Then, when a machine is sold, the purchaser, if he intends to employ a chauffeur, usually requests the agent to direct him to a competent man to act in that capacity. Frequently it happens that the purchaser makes the offer directly to the young man handling the machine at the time, and he can name the terms or refuse, just as he pleases.

This course is declared by agents to be the best for a young man to pursue if he can get into an agency, because it affords him the opportunity to study his machine. The agents prefer it themselves, because it insures a measure of protection to them, as they have the satisfaction of knowing a man is going out with the machine who understands and has faith in it. Hardly a day passes that does not bring an application or two to each agency for an experienced chauffeur. Many of these are left unfilled, because the agent will not recommend men who are not in touch with the business and have some ambition to succeed in it.

Still another course is offered, however, although not conceded to be satisfactory. Young men enter the employ of firms operating automobiles for purposes of transportation. In working for such firms, however, it is held he does not learn the machine as he should, and when it breaks down, is more likely to call for help than he is to get down and find out the trouble for himself. In connection with these firms, the union with which the drivers are affiliated has established a wage scale ranging from $12 to $15 per week.

A WHOLESOME OUTDOOR LIFE.

In addition to considering the material phase of the chauffeur's situation, the life itself is not to be overlooked. It is largely outdoors in the open air that he spends his time. He sees the best parts of the city, the brightest side of life, as it were, as he speeds along the boulevards. In the country he enjoys the best roads, although he may occasionally get stuck in a mudhole, and feel like saying what the golfer does when he finds his ball "bunkered." He dresses for business, not like the dandified coachman, who gets his horses in readiness and then dons his best livery to make a good appearance. His livery is a good working suit and a serviceable cap, with heavy visor, and a pair of goggles to shield his eyes from the wind and dust. His face is flushed with the roses of health and his life, if he takes interest in his work, is one to be envied.

GOOD CHAUFFEURS SCARCE—SALARIES AMPLE.

With all these inducements to the young American in this new occupation, automobile managers cannot understand why it is that first-class young men are so hard to get. They observe with considerable regret that Frenchmen are coming into the country and securing the best positions, in which they are paid salaries that the average business man would consider ample remuneration for one of his head clerks. These salaries await the young man who is toiling his life away indoors, over a desk, and for a paltry sum. Then, the field is broadening each year.

DEMAND FOR "AUTOS" EXCEEDS SUPPLY.

The majority of the factories have ceased taking orders for this year, because they cannot fill them. Next year there will be hundreds of machines put on the streets and a larger number of chauffeurs will be required. The number in the city of Chicago alone has increased 1,700 per cent in three years, and the popularity of the machines has become so great that it is believed to be only a question of a short time when the number will be reckoned by thousands instead of hundreds.

A DAY IN THE TELEGRAPH OFFICE WITH THE OPERATOR

THE FARM BOY'S FOND AMBITION.

It is the ambition of most young men who reside upon the farm to become telegraph operators. This desire usually has its inception soon after the farmer boy begins to make daily visits to the little railway depot, wherein is a young man who grasps a brass key and sends strange signs upon the wire, which, reaching a given point, take the form of messages and are delivered to the person or persons to whom they are addressed.

As, day after day, the farmer boy watches the "city chap" handling the key, the more firm is his determination to learn telegraphing. After his courage has reached a certain pitch, the young fellow approaches the regular operator, and, if things are favorable, the young man is soon installed as "baggage master," or "switch-light tender," and given charge of a few other things about the depot. This work is done in return for instruction in telegraphy.

AS A STUDENT IN THE OPERATOR'S OFFICE.

If the young student, as is not an infrequent occurrence, is quite apt, he learns readily, and within a few months is able to accept a small position at some "way-station," where he earns a salary that ranges anywhere from $20 to $45 per month, but, more usually, from $25 to $35 per month. The ambition of the majority of telegraph operators is to become, some day, train dispatchers and handle railroad "divisions."

A QUICK EAR ESSENTIAL.

In learning telegraphy it is quite essential that the student be young and have a quick ear for different sounds. When he first takes up telegraphy, he is given a sheet of paper, on which are written all of the characters of the Morse alphabet. In addition to the letters, there are certain punctuation marks and numbers from one to nine, with a "naught," which, with a figure one, makes ten.

THE BEGINNER'S PROGRESS IN STUDY.

Then the student begins to study the dots and dashes that have been placed before him. Upon investigation he finds that the letter "A" is composed of one dot and a dash, the dot being placed before the dash. Reverse this by placing the dash before the dot and you change the characters, making the letter "N." In a similar manner, "Z" is three dots, space, one dot, while reversed, is one dot, space, three dots, making the character "&." After the beginner has learned the telegraph alphabet by heart, he begins to practice making them upon the key.

The tendency of all beginners is to grasp the key with too firm a hand, and they are wont to imagine within a very short time that they know more, and are better operators, than those who are teaching them. In this the wise student soon finds out his mistake, and then he begins to learn much more than he ever did before about telegraphing.

EXPERT OPERATORS BORN, NOT MADE.

Some operators—in fact, the most expert press operators—are born, not made. It is as natural for some men to be telegraph operators as it is for others to be great musicians.

A FULL-FLEDGED TELEGRAPHER.

Having mastered the alphabet, the student is set to practicing how to send different forms of messages, figures, etc. In the first stages he usually wants the message before him in order to be able to send it. After a time he is able to send from his head, and a little later, he is a full-fledged operator. The usual time required to learn to send and receive by sound is from six months to a year, according to the aptness of the student. Then it is that constant practice goes far toward making the successful operator. Once the art is learned, it can never pass from you, although your fingers get what old-time telegraphers term "a little rusty," still, they soon limber up and get back into their old-time speed.

In telegraphing it is harder to learn to receive than to send. Perfect sending is only possible with long and constant practice. If a person is nervous it will be shown in the work, for the sending will be "jerky."

TELEGRAPHY AND TYPEWRITING.

In this day of telegraphy, typewriters are as essential as were the pencil and pen a half century ago. In fact, it is almost compulsory in most offices that the person applying for a position as telegraph operator must be able to use a typewriter. In the studying of telegraphy many students seek the telegraph school. This is a mistake, for it is a delusion and a snare. In many cases, the "professor" barely knows the Morse alphabet.

To properly learn telegraphy, the best place for a student is in an office where he can get real "main line" practice. This, and this alone, helps to make the successful operator. In commercial offices, messenger boys are often permitted to learn, and they frequently make excellent operators. The salaries of messengers range from $10 to 20 per month. In the city department of a big commercial office, which is known to the profession as the "Met," the salaries range from $25 to $60. In other branches and on heavy, first-class wires, the average salary earned is from $70 to $85 for nine hours' work.

The salaries of railroad operators range from $25 to $60; that of the train dispatcher from $75 to $100. The latter work in eight-hour shifts, and theirs is one of the most responsible tasks on the road. In handling the passenger trains, especially on a single track, the lives of the engineer, train crew and passengers are constantly in their hands. If a young man, or young woman, wishes to become a telegraph operator, let him or her get into a telegraph office where the before-mentioned "main line" practice can be secured. Telegraphing, while it offers many novelties, is a very trying position, and one that is hard to fill with satisfaction, for a petty error may often cause considerable trouble.

FUTURE OF TYPEWRITING.

The typewriter, as above stated, has become a necessity. Business and newspaper offices cannot do without this instrument. It is only a matter of time when typewriters will be in common and constant use in our schools and many residences. A prediction was made not long ago by a distinguished writer on social questions to this effect: "It is tolerably certain that the typewriter will soon be found in as common use in families as are sewing machines now." The bread and butter problem will naturally bring about this condition of domestic industry.

A DAY ON AN OCEAN LINER WITH THE STEWARD

The steward of an ocean liner has a big job on his hands when he provisions the great ship for its round trip between the United States and Europe. This journey generally takes about twelve days, and with its great cargo of human freight, the vessel is nothing short of a floating city. The amount of edibles and drinkables, to say nothing of other provisions for the passengers' comfort, gives the steward food for thought.

A CREW OF 450 AND A PASSENGER LIST OF 2,000.

In the first place, the ship carries about 2,000 passengers, to say nothing of its big crew, 450 in number.

ASSISTANTS NUMBER 150.

To give an idea of the amount of work upon the steward's shoulders, it may be stated that he requires 150 assistants. He must care for the needs of the passengers, and one of the principal needs is the passengers' stomach supply.

TRIP REQUIRES 200 BARRELS OF FLOUR.

The amount of bread consumed on board, which the steward has to provide, is in itself startling. Over 200 barrels of flour are stored away to help supply the bread and pastry. Next to bread, of course, comes meat. In the old days the steward must needs carry his livestock along and kill it on board. This, however, is all done away with now, for, with the modern improvements have come excellent refrigerating plants, and each ship is equipped with a big one, where tons of meats can be stored away conveniently.

PASSENGERS EAT 54,000 POUNDS OF FRESH MEAT.

Into these compartments, the day before the ship sails away, the steward must pack 20,000 pounds of beef, 14,000 pounds of lamb, 10,000 pounds of mutton, 500 pounds of veal and 500 pounds of pork.

FIVE THOUSAND PIECES OF GAME NEEDED.

Game also is in demand, especially among the first-cabin passengers, and Mr. Steward must see that all his people's wants are gratified. Therefore he packs away a stock that exceeds by far the supply of the greatest hotels in the country. Here also he stores over 5,000 pieces of game, including 500 spring chickens, 500 capons, 200 roasting chickens, 300 fowls, 500 ducklings, 50 goslings, 120 turkeys, 200 pheasants, 300 partridges, 800 squabs and 600 quails.

FRESH FISH, 3,000 POUNDS—SALT FISH, 2,500 POUNDS.

Altogether, the steward must pack away in the refrigerators about 3,000 pounds of fresh fish and 2,500 pounds of salt fish. About 30 barrels of herring, something like 15,000 in number, are also put away in the refrigerators. Besides these come 50 boxes of smoked fish, 500 pounds of lobsters, 400 tins of sardines, 500 pounds of turtles, 20,000 oysters and 10,000 clams.

TRIP REQUIRES TOTAL ANNUAL EGG PRODUCT OF 277 HENS.

Nor does this suffice. Eggs must be had in great numbers The total annual product of 277 hens is consumed each trip.

Nearly a ton and a half of oatmeal must be provided, most of which goes to the steerage passengers.

TWO TONS OF HAM—5,000 POUNDS OF BUTTER.

About two tons of ham and bacon are used. Butter, jams, jellies and marmalades are shipped in enormous quantities. About 5,000 pounds of butter are used, and as much of jams and such sweets.

SUGAR, 10,000 POUNDS—TEA, ONE TON—A TON AND A HALF OF COFFEE.

Of sugar, 10,000 pounds are packed away. Almost a ton of tea and about a ton and a half of coffee are taken on board by the steward and his assistants.

POTATOES NEEDED, 46 TONS.

Enormous tanks of milk are filled and carried over to supply the passengers. Vegetables in great amount add to the stores. Of this latter commodity, 46 tons of potatoes are shipped.

DISHES ALMOST INNUMERABLE.

Besides taking care of all this produce, the steward must see to the china and the utensils used to cook and serve the food in. There are 250 coffee pots and tea pots, 200 sugar bowls, 250 vegetable dishes, 100 butter dishes, besides 10,000 pieces of china for first and second cabin use, and 3,600 plates and 1,500 cups for third-class passengers.

YEAR'S CONSUMPTION OF FOOD ABOARD.

In the course of a year, the steward makes about ten round trips, and in that time he has ordered and served 540,000 pounds of meat, 50,700 head of poultry and game, 200,000 oysters, 25,000 eggs, 15,000 pounds of tea, 25,000 pounds of coffee, 50,000 pounds of butter, 200,000 oranges, and 2,000 barrels of flour.

A DAY ON THE TROLLEY CAR, WITH ITS CREW

To wear a uniform is the sole ambition of many young men. There are two uniformed men on electric trolley cars. One is the conductor; the other, the motorman. In olden times, there were no conductors or motormen as separate individuals; both were one and the same, in the person of the driver. The time was when there was no electricity, and the old familiar "bob-tailed" horse car wobbled along the public streets at an uncertain pace.

To-day the modern trolley car bowls along our thoroughfares, and the ancient horse car has been relegated to the "bone-yard," or cut up for scrap iron and kindling wood.

LONG HOURS AND "SPLIT" RUNS.

In cities like Chicago, the working hours of motormen are long and tedious. They are compelled to get out very early in the morning, and are frequently obliged to work "split" runs, which have a tendency to deprive them of their natural amount of rest. This, of course, applies to the large cities, where the men are at their posts, on an average, ten hours each day.

In order to give the reader an idea of what the duties of a conductor and motorman are, we shall attempt only an outline; brief it must necessarily be, but sufficiently comprehensive to enable the casual reader to understand their daily routine.

THE CONDUCTOR.

To secure the position of conductor, the applicant first visits the office of the street car company, where he fills out an application blank. This done, the applicant is placed on the "extra" list. In the meantime, if his references have been found satisfactory, the "caller" is notified, and very soon the applicant is told to report for duty.

When he puts in an appearance at the barns, he is placed in charge of a car and for several days makes trips under the direction of, or with, a "pilot." The duty of the pilot is to instruct the new conductor how to collect and ring up fares, issue transfers, and learn the various streets on which the line runs.

HIS SALARY.

When the pilot is satisfied that the new man understands the work he is expected to do, he so reports to the superintendent and is relieved from further duty with the new conductor, who then makes his first trip alone. The salary of electric car conductors ranges from 19 to 28 cents per hour. This scale only applies to cities where their organization is perfect, and where the men stand together. The conductor must have $50 in cash to deposit before he makes his first trip. This is remitted when he leaves the service of the company.

HIS WORK AND LENGTH OF SERVICE.

The life of a conductor is anything but a pleasant one, as he is compelled to take considerable abuse which is heaped upon him by a class of passengers who are constantly on the alert to quarrel. Conductors do not, as a rule, remain more than four or six years with a street car company. They become dissatisfied and resign.

THE MOTORMAN'S VEXING TASK.

The motorman, who is so often held responsible for accidents, has even a harder row to hoe than the conductor, for it is his duty to keep his car running on time, and in order to do so he often loses his temper on account of drivers of heavy truck wagons, who insist on holding the right of way, despite the fact that the motorman has signaled several times with the gong.

The motorman must ever be on the alert to prevent accidents. The car may be moving along at a moderate rate of speed, when, without warning, a man runs directly across the track, and if the motorman does not act quickly, the man may be injured or killed. Again, a reckless driver of some vehicle may attempt to cut off the car, which sometimes results in a collision, and is the cause of heavy damages suits against the company.

AN APPRENTICESHIP IN THE SHOPS—THE "PILOT."

Nervous, excitable men do not make good motormen. A steady man, with nerves that can withstand sudden and unexpected shocks, is the one who lasts longest in this capacity. In order to become competent for the position, one must generally serve an apprenticeship in the shops. Even in that case, a pilot is sent along for several days, as in the case of the new conductor.

WAGES OF MOTORMEN.

The wages of motormen at present are from 24 to 29 cents per hour. The work is hard, and therefore competent motormen are almost always in demand.

A DAY IN THE FIELD WITH WOMEN WORKERS

FEMALE FIELD TOILERS NUMBER 450,000.

Four hundred and fifty thousand women toil in the fields of this country. This large number of women laborers is distributed over the United States, but the majority are to be found in the East.

In the vicinity of Jamaica, Long Island, the women in the fields are so numerous as to remind one of Austria or Italy. Everywhere in the East are to be seen the brown-eyed women, busily working out in the sun, in the level fields.

A SCENE AT EVENING TIME.

At evening time, when the sun has sunk behind the trees of Woodhaven, the tourist may see before him many a scene suggested by Millet's "Angelus," the women with the hoe being much in evidence.

LONG ISLAND'S WOMEN FARM HANDS—HOW THEY ARE HIRED.

Long Island's women farm hands are mainly Poles, from Russian Poland. They work for American, Irish and German truck farmers, who hire them by the day. In harvest time, when a farmer needs women laborers, he lays in a stock of $1 bills, and passes the word to one of his men. The man stops the first Pole he meets, and points to a field. Few Poles speak English, but the sign is enough. The man's work is done. Next morning, at the farm gate, 50 women may be waiting.

WHAT THEY DO.

Women are employed for planting onions, for harvesting crops that are picked by hand, such as green peas, string beans, lima beans and tomatoes; for bunching rhubarb and for weeding tender crops, like onions and young carrots, that cannot stand a cultivator.

PLANTING AND PICKING TIME.

In planting time, and in June and September, when the first and second crops of peas are gathered, the outflocking of women is sudden. One may see as many as 50 at work in a plot of a few acres, where, the day before, there was not one.

JUNE PEAS AND BABY CARRIAGES.

In June, when green peas must be rushed to market, and every day's delay means monetary loss, the larger farmers need all the help they can get, and so even women with babies are set picking. Up and down the fields, between long, straight, green rows of vines, stand baby carriages, covered with mosquito netting. While the mothers work, the babies sleep or take in the sunshine.

CHILDREN PULLING PODS.

As soon as children are old enough to pull a pod they, too, are called into service, and at noon, when work stops, and the luncheon of rye bread, cheese and onions is eaten, the scene is festive. Groups gather by families under trees or shelters thatched with green bows. Sometimes, among Italians or French laborers, there is singing.

FARM WOMEN'S WAGES.

The wages received by women farm hands are better than might be supposed. For filling a two-bushel bag of peas a picker gets 25 cents; for beans, half as much. At these

rates a good hand earns $1.50 per day. One reason for comparatively high earnings is curious. The old two-busheled bag has gradually shrunk in size, until now it holds only a bushel and a half.

The farmers have tried to substitute the bushel as the unit of measure, but the women object, and the bag measure is still customary.

A DAY AT THE THROTTLE WITH THE ENGINEER

The locomotive engineer and the train dispatcher hold the two most responsible positions on the railroad. The former clings to the throttle, while the latter sits before a train sheet in the dispatcher's office and regulates the running of the train on which the engineer sits in the cab, with his eye straight ahead.

THE ENGINEER'S APPRENTICESHIP.

To become an engineer, one must previously pass through a regular course of instruction. First, the apprentice who seeks to become an engineer goes to the master mechanic of the "division" and makes application for work.

FIRST A WIPER IN THE ROUNDHOUSE.

He is then placed in the roundhouse as a wiper. This duty consists in cleaning the engines as they come in. His salary ranges from $1.10 to $1.25 per day.

"FIRING ENGINES" IN THE "YARD."

If the applicant shows ability, he is soon promoted to the task of "firing" engines. The next step is when the young "stoker," as he is sometimes called, is placed on a switch engine in the yard, to act as extra fireman. In this capacity he may remain for several months; in fact, some serve from one to three years in the yard before they are permitted to run upon the road.

After a time, however, the novice becomes proficient enough to be given a trial on the road, under the watchful eye of a pilot.

THE FIREMAN'S DUTY ON THE "RUN."

When one or two trips have been made in this way the fireman becomes a full-fledged knight of the scoop, and begins to draw a fireman's pay, which averages about $3.25 per hundred miles. The duty of a fireman is to keep up sufficient steam with which to run the engine, to keep a sharp lookout, when not otherwise engaged, for all track obstructions, and to ring the bell and take signals from the train crew. In addition to this, he is expected to keep his locomotive in splendid condition, and not infrequently does he clean the entire "jacket" every trip.

A HARD AND HAZARDOUS TASK.

The work is hard and hazardous. A broken rail may, without warning, cause a wreck and kill the fireman. Despite the dangers attached to this position, hundreds of applicants are ready to accept it when offered.

STATIONARY ENGINEERS.

In cities, stationary engineers are usually paid by the day, their salaries ranging from $3.25 to $4.50 per day. There are schools where engineering is taught, but the most successful engineers are those who have learned their trade by active service under

an old fireman or engineer. The stationary engineer also serves as fireman, unless it be where the engine and boiler are too large, in which case a fireman and an engineer are employed.

PROMOTED TO SWITCH ENGINEER.

When the fireman has run upon the road a certain length of time, he is promoted to be engineer of a switch engine, doing duty in the "yards." Here he remains for, at least, one or two years before he is placed upon the road in charge of an engine.

FIRST TRIPS AS ROAD ENGINEER, WITH PILOT.

His first trips as engineer are under the direction of an old engineer, who acts as his pilot, and who teaches him the road in order that he may know the grades, the crossings where whistles are to be blown, and obtain any information that is necessary.

FREIGHT ENGINEER.

Then comes the time when he makes his first trip alone. That is a happy moment to the ambitious engineer. With his promotion comes a nice increase in salary he draws "freight-engineer" rates, which are about $4 per hundred miles.

RUNS A PASSENGER ENGINE.

After a time, he is placed upon a passenger train, where, also, he gets an increase in salary, but at the same time, incurs more responsibility and more danger. A successful engineer averages about $160 per month.

A DAY ON THE LOCOMOTIVE WITH THE FIREMAN

HOW THE FIREMAN BEGINS.

THE FIRST LOCOMOTIVE—1830.

The locomotive fireman usually serves an apprenticeship as an engine wiper in the roundhouse. Sometimes he also empties the clinker pits and performs other kinds of drudgery. If his work is satisfactory, he is in course of time placed on the extra-fireman list. If he continues to make himself useful, he is, after awhile, promoted to be a regular fireman.

A PRELIMINARY EXAMINATION.

Many railroad companies require, on the part of their firemen, a good common-school education, and subject them to an examination in certain branches.

DETAILS OF THE FIREMAN'S WORK.

When the fireman is about to make his regular trip, he reports at the roundhouse, draws the necessary supplies, and sees that the lubricators, lamps, oil cans, tank and sand boxes are filled. If he uses soft coal, he sees that it is broken and wet down; that

the cab and its fittings are wiped, the ash-pan cleaned, and that the grates are straight to keep the coal from dropping through. He then compares his watch with that of the engineer.

TWO SYSTEMS OF FIRING.

There are two systems of firing. In the banking system, used with coal having few clinkers, a large quantity of coal is placed in the rear of the firebox, so that the gases and hydro-carbons may be expelled and the coal may become coke. This is little used. The spreading system requires that the coal be broken into pieces about the size of a large apple.

THE COAL WELL IGNITED.

In starting, the fireman sees that the coal is well ignited, so that he need not open the firebox door until the train has gained considerable headway, and the lever has been hooked up, with consequent lighter pull from the exhaust.

IN APPROACHING A STOPPING POINT.

In approaching a stopping point, he shuts down the dampers, and if fresh coal has been recently applied he opens the blower and leaves the firebox door slightly ajar, to prevent the escape of smoke and gases.

THE ENGINEER'S ASSISTANT.

The fireman is the engineer's assistant, and is liable in an emergency to assume the latter's duties, or to take charge of another engine. To a considerable extent, it has been the usage among railway systems to allow engineers to select their own firemen, as it is important that these two trainmen shall be on the best of terms. The selection is subject, however, in a general way, to the assent of the master mechanic.

DIFFICULT AND DANGEROUS.

The work of an engineer and fireman is difficult and dangerous, and requires keen vigilance, close assiduity and iron nerve.

TRAVEL BY NIGHT

In the leisurely days of old, armies went into winter quarters as the autumn waned and active operations were postponed until the next spring. Modern warfare is not regulated by the almanac. Travel is, likewise, now continuous where once it was broken by the alternation of day and night. When men journeyed to or from London, by road wagons, they often spent days upon the road.

THE OLD-TIME INN.

Early or late in the evening, as convenience dictated, the traveler arrived at the door of his inn and was heartily welcomed. Boniface took him in, supplied him with

Chicago & Alton Railroad Company.
SLEEPING CAR.

PULLMAN SLEEPING CAR OF "PIONEER LIMITED"—CHICAGO & NORTH-WESTERN R. R.

good meat and drink, put him to bed in a four-poster, heavily curtained and valanced, aroused and breakfasted him in the morning, and sent him on his way rejoicing in being able to travel in a civilized manner in a civilized country.

A JOURNEY FROM EDINBURGH TO LONDON.

A journey from Edinburgh to London meant spending a week or more on the road, while travelers from near points often slept one night on the way. In this country trips from New York to Chicago were almost unheard of, and even then they consumed weeks.

Dwellers in the country and town alike were not all stay-at-home people, and even if travelers on pleasure or business were comparatively few, the necessities of commerce kept the roads busy.

INTRODUCTION OF THE MAIL COACH.

The first great encroachment of travel on the hours of night came with the introduction of the mail-coach system. Then innkeepers of the old school had good reason to shake their heads and wonder what the world was coming to, as guests who once alighted and passed the night under their hospitable roofs refreshed themselves only during a brief interval, and then clambered into their uncomfortable seats to rattle through the livelong night. Night traveling by stage coach had its many charms, and the poetry of motion of the old English stage-coach was something everybody, or nearly everybody, hoped to enjoy.

EXIT OF THE MAIL COACH.

With the exit of the mail-coach and the entrance of the train, night traveling entered upon a new development; but for a very long time there was very little improvement in the conditions of travel, save in the one item of speed.

NIGHT EXPRESSES.

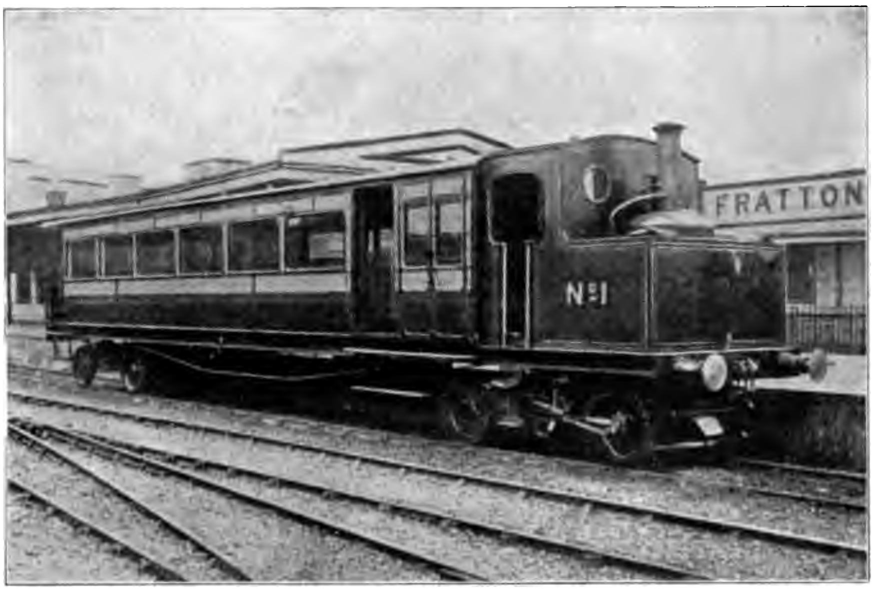
Night expresses, rare at first, became numerous, and passengers many of whom

By courtesy of Lawrence Co
MODERN PRIVATE APARTMENT RAILROAD CAR.
Chicago, Milwaukee & St. Paul Railway System.

could remember the old methods of road travel, became accustomed to the idea of being whirled from London to Edinburgh, or from London to Penzance, during the brief hours of a single night. Although an immensely increased speed was gained,. little was done to provide in any special way for the comfort of passengers at night. They crowded themselves into their corners and slumbered uneasily through the weary hours, as the train thundered and roared through the sleeping country.

ADVENT OF SLEEPING CARS.

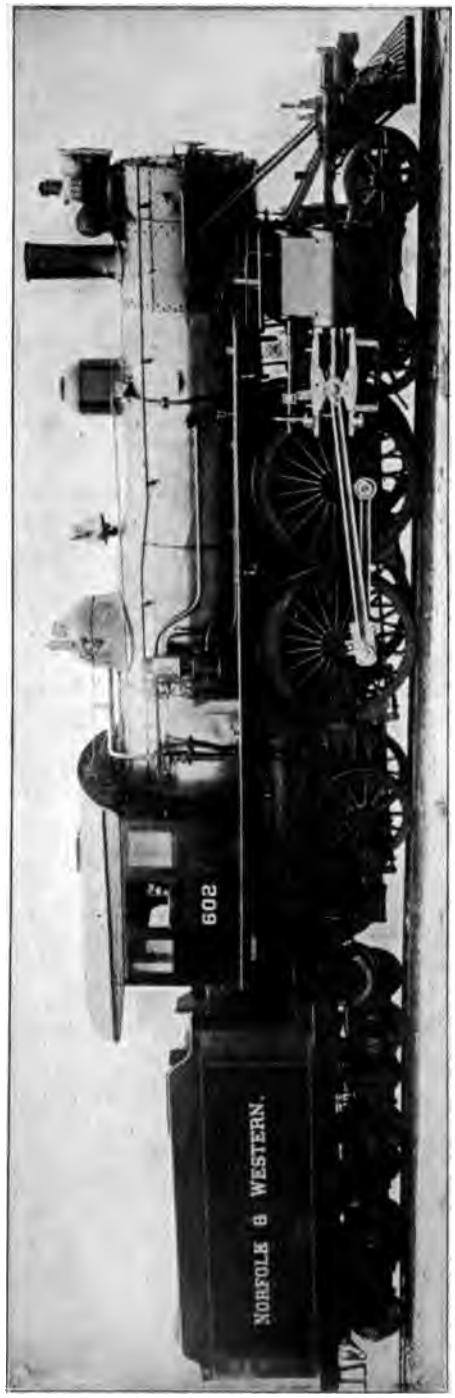
But at last, imported from America, where the great distances to be traversed acted as a stimulant to the ingenuity of inventors, there dawned upon railway managers the idea of sleeping berths, and sleeping cars have worked almost as a great a revolution in night travel for those who can afford them, as the coming of the railway has in the conditions of travel generally. Night travel need no longer be a thorn in the flesh of the traveler who can engage a berth in a sleeper, and even for the much larger number who know nothing of sleeping berths, the immense improvements which recent years have brought in the construction and fittings of railway carriages, and in their smoothness and rapidity of motion, have robbed night travel of much of its old discomfort and wearing fatigue.



THE FIRST RAILWAY MOTOR IN ENGLAND.

The London and South-Western Railway is experimenting with motor-coaches for the lighter suburban traffic. The coaches are fifty-six feet long, and are divided into two compartments, accommodating ten first-class and thirty-two third-class passengers, and one ton of luggage. The engine can attain a velocity of thirty miles an hour in thirty seconds.

A NEW TYPE OF PASSENGER LOCOMOTIVE



THE "BALDWIN." Atlantic Type Locomotive for the Norfolk & Western Railway.

The accompanying cut shows a simple passenger locomotive, which is especially interesting as being of about the normal size attained by the eight-wheel engine before it developed into the Atlantic type. The following are its dimensions and distinguishing features: Cylinders, 19 by 28 inches; the boiler pressure is 200 pounds, and the driving wheels, 79 inches in diameter, give a tractive effort of 21,751 pounds. With these dimensions the eight-wheel engine would have had a grate area of about 29.16 square feet and a total heating surface of about 2352.8 square feet, of which 180 square feet would have been in the firebox and 2172 in the tubes.

EFFECT OF ADOPTING THE TRAILER.

By adopting the trailer, the grate area has been increased to 45.1 square feet, and the total heating surface to 2878.75 square feet, of which the tubes contain 2716.75 square feet and the fire-box 162 square feet, or, in other words, the increases have been 525.9 square feet in total heating surfaces, and 15.94 square feet in grate area.

The result, however, is a locomotive with much greater boiler capacity than could have been supplied to an eight-wheel engine with the same weight per driving axle. The main driving axle, by the way, is of nickel steel, the others being of iron.

Cylinders	19 by 28 inches
Boiler, diameter	62 inches
Working pressure	200 lbs.
Fire-box, length	100 inches
Fire-box, width	64¼ inches
Heating surface, fire-box	162 sq. ft.
Total	2878.75 sq. ft.

Tubes ....2716.75 sq. ft.	Engine truck wheels, diameter....36 in.
Grate area ....45.1 sq. ft.	Weight on driving wheels.....85,790 lbs.
Driving wheel, diameter, outside....79 in.	Total engine and tender, about.289,000 lbs.

THE CANADIAN LUMBER INDUSTRY

In early times the forests of Canada extended in an almost unbroken stretch from the Atlantic ocean to the head of Lake Superior, a distance of 2,000 miles.

LUMBERING NEXT TO AGRICULTURE.

Next to agricultural pursuits, in which 56 per cent of the population are engaged, lumber is the most important industry of the Dominion. The capital invested in it represents $100,000,000, the annual output amounts to $100,000,000, and the annual wage list is more than $30,000,000.

A "WOODEN COUNTRY."

The reputation of Canada as a "wooden country" rests primarily on the fame of its white pine in the province of Ontario.

THE TIMBER OF QUEBEC.

The chief lumber riches in the province of Quebec consist of spruce, with some pine and birch timber, and cover an area of 48,000 square miles.

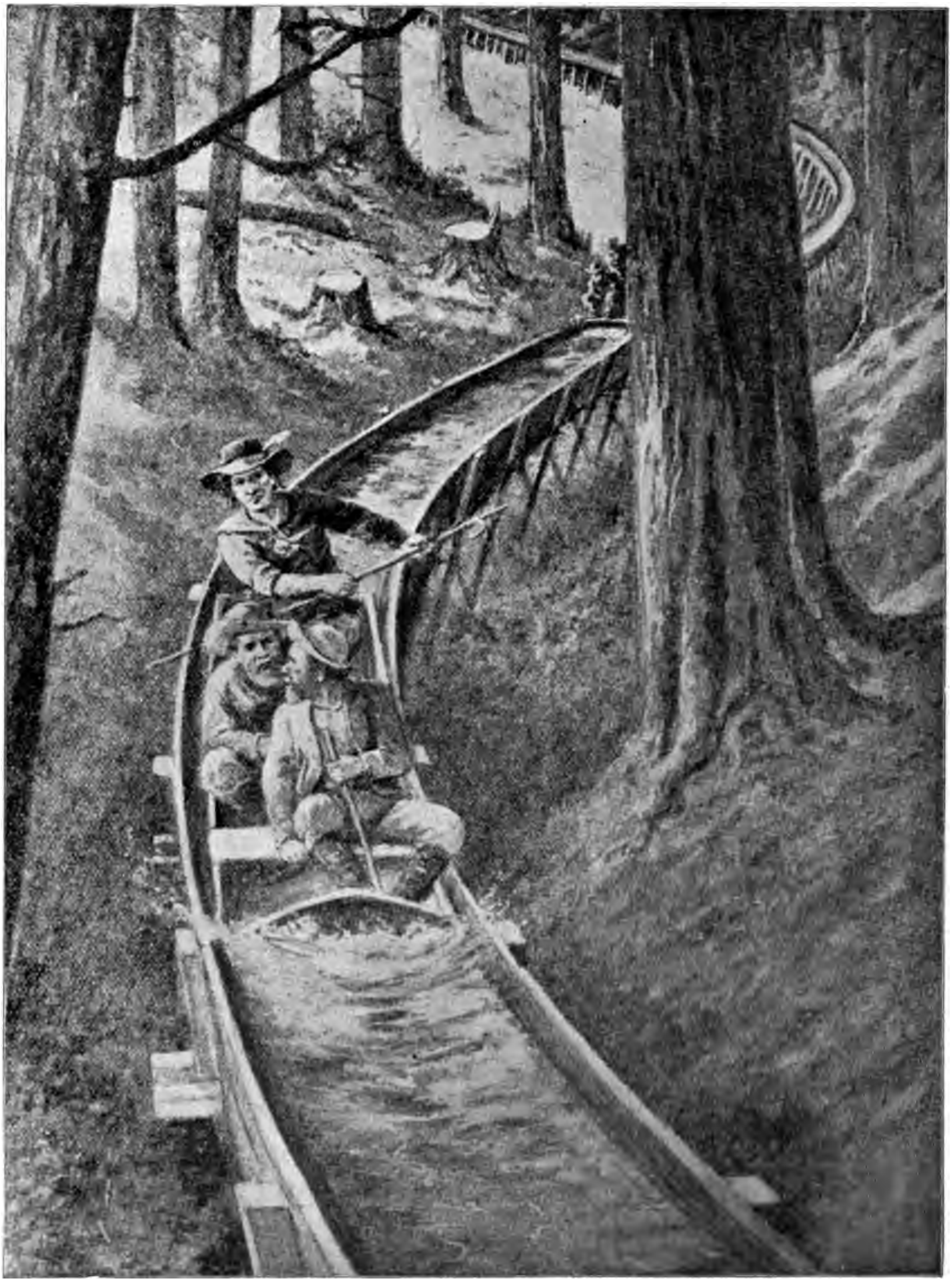
NEW BRUNSWICK'S TIMBER LAND.

In New Brunswick the area of timber land under license is 6,000 miles.

FORESTS OF BRITISH COLUMBIA.

To British Columbia, however, belong the trees most admired in the lumber trade and out of it. Its red cedar is one of the most valuable of timbers. Its forest area is 285,000 square miles, or 182,400,000 acres, and it is really the timber province of Canada.

LOGGING IN CANADA.



LUMBERMEN BOATING DOWN A MOUNTAINSIDE.

THE GIGANTIC DOUGLAS FIR TREE.

Along the coast of British Columbia is grown its most valuable wood—the Douglas fir—which has no competitor in length, strength and straightness. Some of the trees grow to a height of more than 300 feet, and have a circumference of over 50 feet, thus approximating the size of the colossal redwoods of California. The Douglas fir is likely to prove a valuable paper making tree.

British Columbia also contains species of spruce, hemlock, cottonwood, balsam, white pine and red cedar. The last named is, for general purposes, the most valuable wood on the Pacific coast, where all these varieties are to be found.

FLUMES SHOOTING LOGS FROM MOUNTAIN TOPS.

In British Columbia flumes are used to float logs from mountain tops to sawmills. The loggers nail boards together and come down the same way, traveling sometimes a mile a minute.

BRITISH NAVAL DRY DOCK AT ESQUIMALT, BRITISH COLUMBIA.
Showing Water at Normal Level Before Receiving Ship for Repairs.

SAWMILLS.

In this province are 60 great sawmills, with a daily capacity of more than 3,000,000 feet of lumber. The yearly cut of British Columbia is 75,000,000 feet.

In the depth of winter the mill owners, who lease the timber land from the government, send out large gangs of laborers to fell the huge pine and other trees, previously marked by "explorers," preparatory to making them into square timber or saw logs.

FIVE KINDS OF HANDS.

Five kinds of hands are necessary for the woods—the foreman, the hewer, the liner, the scorer and the road-cutter. To these should possibly be added another, the cook.

HANDLING SAW LOGS.

If saw logs are being cut, they are hauled over cliffs and down ravines to the banks of the various tributaries of the prin cipal rivers, where, before the thaw sets in, millions of cubic feet of timber are collected.

MONSTER RAFTS.

When the ice-bound streams are free in the spring, the logs, loosely joined together in rough rafts, are set adrift in the rivers, some of the rafts in New Brunswick covering a space of ten acres.

The method of camping, cutting the trees, getting them to the mills and working them up into the various forms of marketable lumber is substantially the same as that pursued in the timber regions of the United States, and described in the article entitled "Logging in the Northwest."

THE CANADIAN MAPLE.

The maple (Acer), whose leaf is the emblem of Canada, is a lofty tree, with particularly luxuriant foliage. The wood is very close-grained and hard, highly ornamental, and is esteemed for the beauty of its fibre. When polished it possesses a silky lustre. It is used for heavy furniture, cabinet work, and for railway carriages, where strength is required.

AGRICULTURE IN CANADA

THE SOIL IN UPPER CANADA.

In the vast plateau stretching westward through Upper Canada, on both sides of Lake Erie, farming is a comparatively easy vocation. The yield of wheat is abundant in the southern portion, but north of the wheat limit the land is poor and rocky.

In the wheat region, cattle and dairy products also constitute large items in the farmer's receipts.

THE GENERAL PRACTICE.

It is the general practice to allow the land to remain for two years in artificial grasses and clover, to break it up in June, and sow wheat in autumn. The only formidable foes encountered by the Canadian farmer in raising wheat are rust and mildew, which early sowing largely prevents. When these are absent, the comparatively high temperature of the autumn pushes forward the wheat plants, and produces a thick carpet of vegetation.

INDIAN CORN.

On the inferior lands some fine crops of Indian corn are grown, being planted in May and maturing about the middle of September.

LOWER CANADA.

Much of the soil in Lower Canada is a dark-colored sandy loam. Timothy grass grows well on it, but the clovers only last one year. Oats, barley and potatoes are the staple crops in the island of Montreal and other parts.

ALONG THE ST. LAWRENCE.

There is a variable breadth of alluvial soil along the banks of the St. Lawrence River, but for some miles west of Quebec little arable land is observable. The area of first-class farming land in Canada east is not extensive.

THE SWAMP LANDS.

The deposits of swamp muck found more or less in all parts of Canada, result from gradual accumulation of partially decomposed vegetable matter—the remains of successive generations of plants, chiefly aquatic. These deposits furnish the farmer a liberal supply of plant food for his crops. If dug in autumn, thoroughly aired, exposed to the winter's frosts and then mixed with lime or marl and wood ashes, the compost is much valued as a fertilizer by the Canadian farmer. Marl, which is essentially carbonate of lime, is chiefly found in connection with the muck beds, and when readily obtained is the cheapest article which the farmer could use for the purpose.

CANADA'S WHEAT CROP.

The production of wheat in Canada for the year 1902 was 87,555,891 bushels. This amount gives the Dominion the ninth place in a list of 22 of the great wheat-producing countries of the world, the combined crop of which, in 1902, was 2,820,333,614 bushels.

PERCENTAGE OF FARMERS TO POPULATION.

The Canadian census of 1890 showed that the number of persons engaged in agricultural pursuits in the Dominion of Canada—farmers and farmers' sons—was then 649,506. These and their families then made up 45 per cent of the entire population of the country.

NEW APPLICATION OF THE GRAIN PRODUCT.

The very low prices which prevailed for wheat and the coarse grains for some years after the taking of the 1890 census, led a large number of farmers to turn their attention to more profitable methods of disposing of these crops than by their bulk sale in the markets.

EXPERIMENTAL FARMS.

About that time a central experimental farm, with several branches, was established by the Dominion parliament for the purpose of making agricultural tests whose results would enable the farmers to derive more profit from their labors.

The experiments conducted at the government farms demonstrated the fact that wheat, as well as other grains, might be made a greater source of profit by converting them into beef and pork than by selling them in their crude state, and this course was pursued on numerous farms with pronounced success.

THE DAIRY PRODUCT.

The investigations made under government supervision also showed that the feeding of these grains, mixed with suitable succulent food, such as ensilage, to cows and converting their milk into cheese and butter was more profitable than selling the grain. In consequence of this, the dairying industry grew very rapidly, and the demand for first-class dairy products became almost unlimited.

A DOUBLE ADVANTAGE.

The Canadian farmers enjoyed a double advantage as a result of the change of method, in that the elements of fertility taken from the land during the growth of their grain crops were largely restored to the soil by the barnyard manure.

Moreover, when buttermaking was carried on during the winter months, additional employment was given to farm hands during that season, and the oversupply of grain fed to cattle and swine, reduced the excess on hand and tended to restore the equilibrium of the market.

DISTRIBUTION OF SEED-GRAIN.

The experimental farms not only tested the varieties of grains, but furnished the farmers proper seed samples for general growth, thereby improving the quantity and quality of the various cereals grown in Canada. These newer and more productive sorts of grain are rapidly replacing some of the less prolific varieties formerly cultivated.

OSTRICHES AND OSTRICH FARMING

The antiquity of the ostrich (Struthio Camelus) is attested by its mention in the Bible.

Herodotus also refers to a custom of a certain desert tribe in Lybia, of making garments and shields from ostrich skins, and warriors from a very early period wore ostrich plumes in their helmets.

A NATIVE OF AFRICA.

The ostrich is a native of Africa, and is commonly distributed over the boundless wastes and plains of Great Namaqua and Damaraland. From Southern Algeria to the interior of Cape Colony, the bird is found wherever an open country with Karoo or desert land suits its nature. The average life of the ostrich is 60 years.

AN OMNIVOROUS BIRD.

In its wild state the ostrich is omnivorous. It greedily devours seeds, berries, fruit, grass, leaves, beetles, locusts, small

RAISING OSTRICHES.

birds and animals, snakes, lizards, sand, grit, bones, stones and pieces of metal.

ITS NEST OF EGGS.

According to the Arab, the complement of eggs on which the solitary ostrich sits at night for hatching its young, is 25 in number, but few nests have been found containing more than sixteen. Each egg weighs about 3½ pounds.

POLYGAMOUS.

The male ostriches are polygamous, and fight vigorously in the breeding season for the possession of the females. Each male ostrich associates with three or four hens, all of which lay their eggs in one large nest, scooped out in the sand, and relieve each other by turns at incubation.

THE INCUBATION.

The period of incubation is six weeks, and the male bird takes his regular turn in sitting on the eggs, late in the evening. The young run as soon as hatched.

THE EGGSHELL.

The shell being thick and strong, is used in various ways, but mainly as a vessel for water. Bush girls and Bakahari women, who belong to the wandering Beckuana tribes of the Kalahari district, carry from their dwellings to the fountains a kaross or net containing from 12 to 15 eggshells, with a small aperture at the end which, after filling with water, they stop up with grass.

DOMESTICATION OF THE OSTRICH.

More than a century ago many farmers at the Cape had tame ostriches on their farms, which fed at large and supplied their owners with plumes, which were made into brooms for driving away the mosquitoes.

In 1859 the Acclimatisation Society of Paris offered premiums for the successful domestication of the ostrich in Algeria or Senegal, and for breeding ostriches in Europe. From 1866 the new industry of ostrich farming spread and flourished throughout Cape Colony, although in 1865 there were less than 100 domesticated ostriches in Africa.

VALUE OF THE FEATHERS.

About twelve ostriches are able to subsist upon an acre of garden ground, sown with lucerne and well watered. Three pluckings from 15 ostriches, at intervals of 8 months, yielded the owner of one of these farms £240, which is at the rate of £120 a year, or £8 per bird. England and France pay to the Cape Colony farmers $8,000,000 a year for feathers, and buyers in the United States pay $2,000,000 a year.

Loose stone walls, costing from a shilling to 18 pence per yard, or fences composed of four horizontal wires of galvanized iron, surround the ostrich enclosures.

THE YIELD OF FEATHERS.

A full grown male ostrich will yield about 90 first-class feathers, which will weigh one pound and sell for about £45. Second-class feathers are worth from £20 to £30 per pound.

NATURE AND SPEED OF THE OSTRICH.

The ostrich is a solitary bird, timid and shy in habit, but often headstrong. When at full speed and going before the wind, its pace is simply amazing, and it is said that no horse ever fairly ran one down.

OSTRICH FARM IN CALIFORNIA.

An enterprising man named Edwin Cawston established an ostrich farm about 10 years ago in Pasadena, California. In

a miniature park he has 100 mature ostriches, and several rooms full of incubators. Mr. Cawston receives annually $10,000 as admission fees from spectators, and $3,000 a year from the sale of infant ostriches, which are sold at $25 each.

LOGGING IN THE NORTHWEST—IN THE EARLY DAYS

In the early days of this industry, especially in the Maine and Minnesota pineries, where the modes of operation were identical, the logging party usually built their camp about the beginning of the fall season and then cut the main logging roads, which had to be straight, twelve or more feet wide, smooth and level. Whole trees, trimmed of their branches, were hauled, the bark being removed from the under side so that it would slip easily on the snow. One end of the tree trunk was loaded on a bobsled, the other part being dragged along. In this way the tree was taken to the landing on the shores of the lake or river, where it was rolled off the sled and the sawyers cut it into logs, cutting a mark of ownership on the side of each log. The logs were then ready for the drivers, in the spring, to roll them into the water.

THE OLD-TIME LUMBERING CAMP.

The old camp, as it used to be built from 1848 to 1860, was simple but very handy. Two large trees, of the full length of the camp, were procured and placed about 20 feet apart and two base logs were cut for the ends. Each end was run up to a peak like the gable of a house, but each side slanted up as a roof, from the long base tree at the ground to the ridgepole. This roof, constructed with level stringers, was shingled.

A chimney measuring about four by six feet formed of round poles and calked was built in the middle of the roof and the fire was directly underneath it in the middle of the room.

THE FIREPLACE.

Six stones were arranged, three at one end and three at the other, as the fireplace. Logs about eight feet long were laid and burned in a hole between the two rows of stones. When the hole was filled with live coals it was a fine oven for cooking meat or baking beans and bread.

THE SLEEPING QUARTERS.

The places for sleeping were next to the wall behind benches of hewn planks built near the fire, and the bed consisted of fir boughs laid on the ground.

THE MODERN LOGGING OUTFIT.

The modern logging outfit is different. Two bobsleds are placed one behind the other and are fastened by two chains crossed in the center.

With a tackle and fall, logs are rolled up and loaded on these sleds, sometimes to the height of ten feet. Horses or oxen are used on the tackle, and a load takes from four to ten thousand feet of logs.

ICING THE ROAD RUTS.

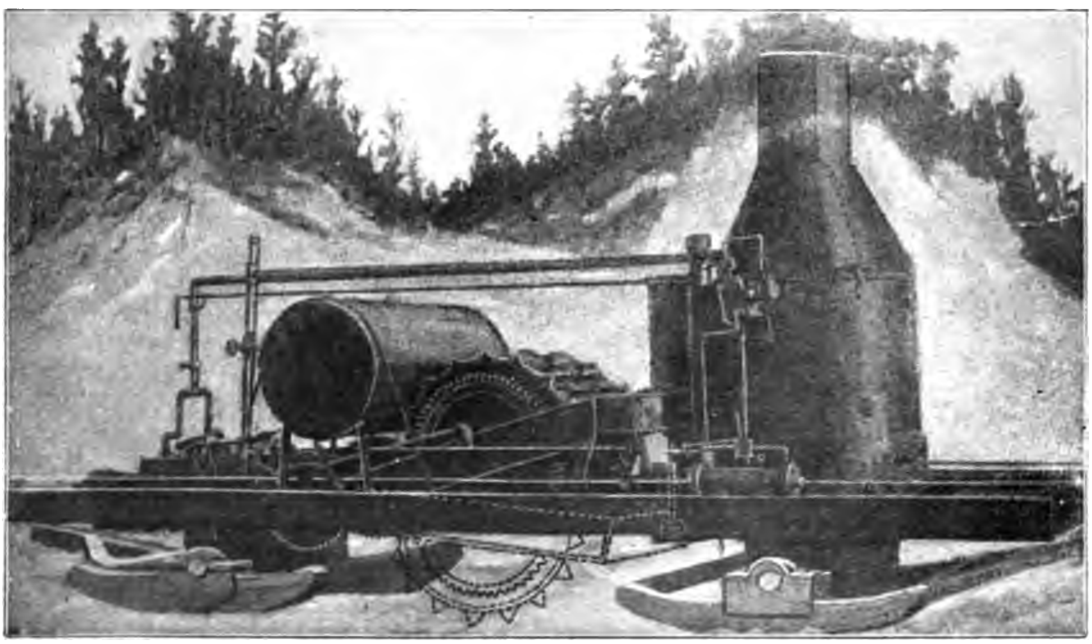
It is made possible to draw these very heavy loads by icing the ruts of the logging roads. At the beginning of the logging season, and whenever snowstorms or continued wearing makes it necessary, water

A "SNOW LOCOMOTIVE," USED TO DRAW LOGS DURING WINTER SEASON.

tanks on runners are drawn along the roads, supplying a small stream at each side. The resulting narrow courses of ice bear up the sleds under the great weight.

FELLING WITH THE SAW.

Instead of chopping down the trees as in the olden time, they are now sawed off at the stump.



THE ENGINE OF A "SNOW LOCOMOTIVE," SHOWING TRACTION WHEEL RAISED.
(Dotted lines show position when in operation.)

BOOK V

SOLID FOOD FOR SOUND MINDS

READING THAT MAKES ONE WISER AND HAPPIER

A COUNTRY BOY'S CHANCES IN A LARGE CITY

AT a certain average age, begins the yearning for city life of the boy reared amid rural scenes. Then comes the "winter of discontent," which too often ends in his utter undoing.

The abandonment of agricultural pursuits by the country youth, and his entrance upon a city career, are likely to furnish a cause of trouble both in city and country.

GROWING NEED OF "HELP" ON THE FARM.

Agriculture now, more than ever, needs the service of all those bred to the farm and thoroughly familiar with its daily routine. The summer of 1903 brought clamorous demands from numberless farms in the grain-growing states for help in caring for the waiting crops, and multitudes of farmers were only too willing to accept inferior workers at from $2 to $3 per day to meet the requirements of harvesting.

CROWD INTO THE CITY.

On the other hand, hosts of farm lads, dissatisfied with the simple and unvarying course of farm life which, from distorted views, had become monotonous and irksome to them, plunged into the uncertainties of the already thronged cities, only to discover that their expectations were illusive and vain. So crowded have become the avenues of business endeavor by seekers after clerical employment that commercial enterprises in the important centers of trade can arbitrarily fix the wages paid to applicants for work. The conditions are such that great commercial houses while ever competing for patronage, never compete for help, as necessity compelled in case of the farmers before mentioned.

CAUSES OF OVER-SUPPLY OF CITY "HELP."

The natural increase in the city population from births, the constant accretions from country sources, the large extent to which women and girls have been substituted for men and boys in stores, offices, factories and shops, and the endless output of graduates from the business colleges, have barred the way to "positions" against thousands of disappointed people.

ONLY THE FITTEST SURVIVE THE STRAIN.

Unless the boy from the country is the possessor of rare qualities, city life is likely to prove to him a delusion and a snare. Only the fittest, in such a change, can survive the strain. As a rule, the youth bred to city life is much more likely to succeed than his country competitor for a job, because he is imbued with the push of the bustling mart, and is thoroughly familiar with the surroundings. He is, moreover, less liable to succumb to the temptations that hedge about him because he is safeguarded by the attractions and restraints of home.

Let the country boy, except in rare instances, stay at home, at least until he has saved enough of his sure earnings to begin mature life in an independent way. Let the country boy remember that the country is better far than the great metropolis, for mental and moral development, and for the establishment of strong individual character. The country, and the small town (not the city) give to the nation its towering celebrities. What great scholars, orators, theologians, scientists, lawyers, or statesmen have sprung from the environments of a great municipality? Let the wise country boy be mindful of these things, and stay where he is until he has laid the foundation of a successful career.

VALUE AND CHARM OF A GOOD LETTER

Letter writing will soon be numbered among the lost arts. It has come about through the increase in postal facilities that we have to write so many letters that we do not care to spend overmuch time on any one, or any series. The modern methods of travel which seem to have annihilated distance, have given to correspondence less importance in our eyes than it formerly had.

SCRIBBLING LETTERS COMMON.

People no longer write letters; they scribble them. But what others do in this connection is, or should be, nothing to you. It is your creed that all things should be done well. In letter-writing, particularly, you will take great pride and pleasure. Your letters stand for you. You do not enter a friend's house, utter half a dozen poorly expressed commonplaces, and then depart. Nor should your letters show as little care. Representing you, they should show you at your best. The envoys of your love, your friendship and your interests, you should see to it that nothing about them is disappointing.

THE LETTER A MESSENGER OF ITS WRITER.

Every one of them has need to be a worthy messenger, now to console, now to amuse, now merely to pass the time of day. There is no present so sweet to receive as a beautiful letter. In your letters trivialities may have ample room. To those you love, they are very pleasing, running over with

such little details as correspond with chattering,—little details,—the unimportant things that separation makes important.

THE HEART SPEAKS.

Nothing more is required than that your heart should be in the matter. "The scholar sits down to write," says Emerson, "and all his years of meditation do not furnish him with one good thought or happy expression; but it is necessary to write a letter to a friend—and forthwith, troops of gentle thoughts invest themselves on every hand with chosen words."

GLOW OF AFFECTIONATE LETTER.

An affectionate letter! What a glow it leaves in the heart! It is a disappointment when the postman passes the door. But to take pleasure in receiving letters is not consistent with a neglect in writing them. To be sure, they take up much time. But it seems very certain to you that the time is not wasted. It is so much pleasure that you can give away at the cost of a little red stamp. You make your letters members of your life. What you do, what you are, what you think,—that you set down, and all else that comes into your head. Your letters are very intimate.

A GOOD LETTER MIRRORS THE MIND.

A good letter is the mirror of the mind. It is something that flashes. It is an epigram. Herein lies not the least benefit of letter-writing—that many things must be set forth in so small a space.

SPONTANEITY IN LETTER WRITING.

Letters are never so charming as when they are written spontaneously—when they arrive unexpectedly. Letter writing is hard work, and the mood for hard work is illusive. Practice writing; make your letters characteristic of yourself always.

COURTESIES OF LIFE

In the present scramble for wealth, position, rank and recognition, we are fast losing sight of the more important courtesies of life. The future of our families and, incidentally, the well-being of our old age depend more on our home existence than upon any advancement we may make in the different enterprises which occupy the minds of men.

AMENITIES OF HOME LIFE.

If some are indifferent enough to popular opinion to devote more time to the civilities of their homes than is the general custom, let us recognize the fact that their judgment is nearer right than that of others who are more prominent. While we must acknowledge the great social good accomplished by those who strive in the interest of the public, we must admit that the most useful sphere for American mothers and, in most cases, daughters, too, is the home.

FAMILY TRAINING.

Primitively, woman was a helpmeet, a complement, not another self—the two parties to marriage filling their respective spheres, forming a perfect unit, and yet with each one's work impossible to the other. In spite of all contrary opinion, woman's highest mission is to guard the sacred precincts of the home, for, before any other training

whatever, comes the family training,—that preliminary training in which correct personal habits, respectful treatment of elders and superiors, obedience to authority, courtesy and morality are inculcated. Freedom from home control in the young is painfully evident, showing the need of a closer watch and guard over the domestic circle, and the imbuing of offspring with a greater regard for parental authority and parental judgment. Children speak to their parents and act toward them in a manner that would have been shocking a few generations ago.

Many parents fail to exact the courtesy due them from their children, fearing that the child may consider it a vain assumption of dignity. This negligence is followed by a less respectful demeanor toward father and mother and those in authority. Courtesy, or true politeness, is not a garb to be put off and on at will. On the other hand, it improves with use.

If we daily maintain the courtesies in home life which we extend to associates and acquaintances, our politeness in social circles would not savor so much of affectation. Chesterfield advised his son to use good grammar even when talking to his dog, in order to acquire the habit of correct expression. It is well to observe this rule with all the minor attainments which go to make us agreeable. Unless we respect ourselves enough to practice the common civilities, we cannot be anything but brusque and impolite. Our manners are often self-conscious, crude and vulgar. "If they don't like my way," says one, "they can take the less of it." Until such misdirected individuals enter into a circle the manners of which are more reserved and refined than their own, they have no realization of the fact that their ways are unacceptable, or that they are different from those of more agreeable people.

Brusqueness is not always manifest in what one says, so much as in the manner of speaking of an ordinary matter, or in an abrupt entrance, a disrespectful or lounging attitude, or a noisy salutation. "Every heart knoweth its own bitterness," says the Holy Writ. And it is an unpardonable familiarity, and also a display of egotism, to inflict upon others a minute description of the details of one's own small affairs.

SINCERITY AND KINDLINESS.

Anybody can recapitulate the troubles of the shop, of the kitchen, the nursery and the petty grievances of the neighborhood. We must learn to take human nature as we find it, and, at the same time, search for the brightest and best qualities among those with whom our lot is cast. Good will to our fellows and sincere motives should be the underlying principles which govern our intercourse with mankind. It is no hard task to cultivate a kindly feeling for others. There is no veneer that will stand the test of time. Our shallow courtesies may please for awhile, even if but occasionally assumed; but, in an unguarded moment our rougher self is revealed. The only solid basis of true politeness is the possession of right principles and virtuous character, the leading of a true life. Natural kindliness of heart and sincerity of intention must be back of all our actions. Unfeigned courtesy is best acquired and maintained in the daily intercourse of our homes.

THE HIGH SCHOOL AND ITS PART IN EDUCATION

The American High School is an important factor in the educational work of today. In a state of the size of Illinois there are said to be 310 high schools. The same estimate holds good in other states with the same number of inhabitants.

NUMBER OF STUDIES TAUGHT IN ILLINOIS HIGH SCHOOLS.

The number of study subjects offered in individual schools varies from 10 to 30. The total number of studies taught in the Illinois high schools is 49. Of these, eleven are termed constants—that is, they are taught in more than 75 per cent of the schools—and eight of them are taught in more than 85 per cent of the schools. These eleven branches in the order of their prominence, are algebra, geometry, physics, botany, Latin, English literature, zoology, physiology, general history, civic history and physiography.

Mathematics, literature, language and science, each has its place in almost every high school of the state. The belief that another constant is essential to the completeness of this list is rapidly growing. The demand for manual training is generally conceded, but there are as yet very few instances of its introduction.

ATTENDANCE AT THE SCHOOLS.

The data in regard to attendance shows the total enrollment of the schools reporting to be 34,824. Of this number there are 11,773 boys and 23,051 girls. The total attendance of seniors is 4,390, with 1,655 boys and 2,735 girls. It is noted with enthusiasm that, while the total percentage of boys attending high schools is but 33.8, the percentage increases to 37.5 for the senior class. Among teachers the number who are normal school graduates gives a percentage of 15.6, while the college graduates show a percentage of 54.4. The number of teachers who hold master's and doctor's degrees is large.

These statistics constitute a fair average for other states, with the exception, possibly, of New York and Pennsylvania.

The following table shows the hours devoted to each branch of study:

Algebra	47,560
Geometry—Plane	33,840
Geometry—Solid	10,960
Trigonometry	1,010
Arithmetic	3,540
Bookkeeping	7,610
Descriptive geometry	63
English grammar	480
English composition	31,620
Rhetoric	20,860
English literature	52,170
Latin	100,350
German	27,540
French	9,400
Greek	9,120
Spanish	170
Swedish	440
General history	30,410
English and American history	21,600
Ancient history	95
Greek and Roman history	10,500
Mediæval and modern history	670
French history	140
Civics	15,200
Political economy	2,210
Physics	38,660

Chemistry	20,840
Botany	19,650
Zoology	19,070
Biology	690
Physiology	14,530
Astronomy	4,740
Physiography	14,880
Geology	2,390
Psychology	380
Commercial geography	300
Commercial law	2,320
Constitutional history	45
Drawing—Free-hand	9,630
Drawing—Mechanical	320
Elocution	350
Formal spelling	220
History of commerce	260
Manual training	1,120
Music	760
Mythology	30
Pedagogy	140
Physical culture	420
Reviews	360
Stenography and typewriting	480

These figures comprehend all the high schools in the State of Illinois.

THOUGHTS ABOUT HOME

The average theory of home life is that the happiness of home depends almost solely upon the wife and mother; that woman's first and highest mission is her home; that there are no clouds that ever overhang the home that sunbeams, bright and joyous, cannot penetrate. Love and reason, hope and aspiration, blend in a glorious, gorgeous rainbow of promise that arches the holy circle of home.

WHAT HOME MEANS.

Home means much in this twentieth century; it means all that makes life really worth the living. It is the object to which all unselfish endeavor is directed. It is the one solitary spot in the desert of the world where all those principles taught us in childhood preserve their living green, and reach out of the twilight of the past into the sun-gold of the future, preserving unbrokenly for generations to come the lessons therein taught.

THE WORD HOME.

Home is a word that we love to linger on. It brings around our hearts a confiding trust and repose. It has been said that there is no sweeter word in all the dialects of earth than the word home, unless it be the word "Mother," and home always suggests her and clusters about it more happy and hallowed associations than any other place. Its impressions are the strongest, deepest and most ineffaceable. It means life after death, the hereafter, to all who are blessed with offspring, in whom their own characteristics and energies are perpetuated.

It is the golden chrysalis, wherefrom the hope of the future takes wings at last. The home life is the nucleus around which all life has its growth, and that its tone and coloring are transmitted not to one generation alone, but to many generations, is an indisputable fact.

MOTHER.

Some writer has said that each member of the family contributes his or her share towards the making of the home, but the principal, presiding spirit is the wife and mother. She is, or should be, its life, heart and center.

The mother holds the key of the soul, and she it is who stamps the coin of character for her sons and daughters. Then crown her queen of the home. We should make our homes as tasteful as possible and beautify them with all the adornments which nature and our purse can provide. We should adorn our grounds with those natural attractions which the Creator has so profusely spread around us, and especially should we adorn the family circle with noble traits and kindly inclinations, fill the atmosphere with affection and thus induce others to love rather than fear us.

WHAT MAKES AN IDEAL HOME?

The ideal home is not made up simply of furniture and fixtures and decorations. The furnishing may be elaborate and luxurious, the decorations of the most artistic character, the arrangements for comfort perfect in every respect. Still, if it lacks the sunshine and warmth of love and affection it is not an ideal home; it is cold and dull and without life. It is marvelous, too, if the home lacks this element, how soon it will be manifest. The absence of it permeates the very atmosphere. There are homes, however, whose memory is a perpetual joy, and to which we always turn with emotions of gladness and pleasure. Neither statuary nor paintings may grace niche or wall. They are plain and unpretentious, lacking everything but the necessaries of life. Yet they are filled with beauty because of the spirit of love and affection abiding therein.

DUTY OF FATHER AND MOTHER.

It is the duty of every father and mother to make the home attractive. Make the living rooms pleasant, give them the sunniest side of the house. The plant that lives in the shade is sickly and unsightly.

ORDER.

One of the indisputable conditions of a pleasant home is the preservation of order. Have a place for everything and put everything in its place. "Order is heaven's first law." We should cultivate a habit of reading, if we have it not. We need it as well as we need air and sunshine, sleep and food. How refreshing it is to be able to lose one's self, even for a short time, in places where nature reigns.

BOOKS.

The humblest country boy or girl, kept at home by poverty and having to perform menial labor, may, if he will, with the aid of books, use the eyes and ears and brains of all men, everywhere and in all ages.

To-day the whole world of thought is before us and at our disposal, in every city and village, for a mere pittance. Every home should have a library. What bread and other articles of food are to the body books are to the mind, and, as the mind craves knowledge, its wants should be supplied or provided for with great care. A library always affords the choicest companionship. Some books are inspiring. Every page and sentence stirs us to higher motives and a higher life. Others inspire us with awe and veneration as we read them. Others are fragrant; they breathe the air of the mountain, the hillside, the valley, the home. Those who have a well-selected library may dine with kings and reason with philosophers, associate with poets and painters, and number the master thinkers of all ages among their personal friends. A home without books is a dreary, inhospitable place. A good book is always a genial companion. We should select our libraries with the greatest care, beginning them with the Bible, and making the poets

our especial friends, adding, each year, such books as may come within our reach. This is a sure means of refinement and education.

MUSIC.

The home is almost as incomplete at the present day without some musical instrument, as it would be without books. We should cultivate a taste for music, both instrumental and vocal. Music is classed among the fine arts, and is taught as a science which all may learn. Music has a refining, inspiring and patriotic influence. From the mother's lullaby to Mozart's requiem masses, in the masterpieces of Haydn and Beethoven, we can mark the influence of music. Who has not felt the quickening spirit while singing, or listening to, the sweet melody of the gospel hymns? Have we not the testimony of thousands that martial music thrills the soldier with a spirit of bravery on the field of battle?

It has been said that no great musician has ever been convicted of a great crime. Shakespeare, as also well known, makes melodious utterance a test of civilization. Besides bespeaking a soft voice for a woman, he says: "The man that hath no music in himself, nor is moved with a concord of sweet sounds is fit for treason, stratagems and spoils."

NATURE'S MELODIOUS SOUNDS.

We are certainly a music loving people. Let us have it, then, in the home. Nature has done her part generously. She sings to us through warbling birds, and whispering pines, rearing waves and whistling winds. The least we can do is to join in the melody of nature, and by so doing, we add one more to the many bulwarks which should ever protect and surround the home.

MODERN METHODS OF COMMERCIAL EDUCATION

Commercial education is considered in these days to be a very important feature of the equipment of young men for business, and the development of the commercial training school has been very extensive. Not only have business colleges grown to a stage of high efficiency themselves, but as an outgrowth of them commercial courses have been introduced into the public and high schools, and some universities have established departments of commerce.

THE PUBLIC BUSINESS-SCHOOL.

The public business-school has become a very close competitor of the private institution of the same character, and as a consequence, the privately conducted institution has been forced to avail itself of the most improved and scientific methods in every particular.

THE TERM OF STUDY.

The modern business college of the most advanced type instructs its pupils in bookkeeping, shorthand, typewriting, business methods, commercial law, correspondence, and kindred subjects. The time required to complete the course is from four to eight months, varying with the adaptability of the student. One college announces that some of its particularly ambitious students have finished the complete course in from eight to ten weeks.

It will thus be observed that the student

may advance as he chooses. There are no classes in which all do the same work. The system of instruction adjusts itself to the individual, and every attention is paid to the fact that the student is seeking at the earliest possible moment to devote himself to active business affairs. Each department of these schools is highly developed. In bookkeeping, for example, the fact is recognized that under the high-pressure methods of modern business, there is no time to train employes in business. The young man or woman who wishes to take a position must be ready to perform his or her duties at once. Consequently in the bookkeeping course, each rule and the reason for it are carefully explained to the student. He is given school currency, notes, drafts, invoices, etc., and works on living business transactions, instead of spending weeks in the dry study of mere text-books.

Every detail of a modern office is illustrated, and students are given actual practice in letter filing, letter-press copying, indexing and drawing up all kinds of business papers. The students are well grounded in arithmetic, and taught to be rapid and accurate in figure. They are also taught to write, not only speedily, but well. They take a course in common law, are drilled in letter-writing and spelling, obtain a complete understanding of the latest labor-saving methods of accounting, and are trained to perform all the details and routine of office work.

SHORTHAND.

In teaching shorthand the students are usually divided into three grades. When the principles of shorthand have been mastered, speed in writing is attained through systematic practice under the supervision of a skilled and experienced teacher. This point, in the best schools, is reached in from three to five weeks. The grades are then as follows: 1. Where dictation is at the rate of from 30 to 90 words a minute. 2. Where the rate is from 90 to 110 words a minute. 3. Where the rate is from 110 to 125 words a minute.

A MODEL OFFICE.

Some of the colleges have introduced what is called a "model office," where shorthand holds full sway. This office has every appliance and convenience of a modern commercial office. Here are duplicated the exact conditions that obtain in the offices of the largest and most progressive business houses.

AIDS TO PROGRESS IN STUDY.

Among the facilities for study are the newest style of desks, new typewriters, with the very latest improvements, the leading card-index systems, folio indices, letter presses, the mimeograph, the newest style—everything the student may be required to use later in actual business. All pupils regularly devote a considerable period of their time to this work, familiarizing themselves with the details of office routine, and obtaining a practical instead of a theoretical knowledge of business systems and methods.

THE SCHOOL CORRESPONDENCE.

The school correspondence, as well as that of the employment department, is conducted in this office. The instructor, who is here the employer, in effect, gives each student, in turn, actual dictation. This is then transcribed, passed to the instructor for examination, and, if necessary, is corrected. The student then attends to the copying, indexing, cross-indexing and

mailing of the correspondence. It is a part of the plan of the more progressive schools to assist all their students to obtain positions. To do this effectively, a thoroughly systematized employment department is maintained, which keeps in close touch with a large number of business firms, from which requests for employes are continually received. Banks and trust companies have regularly on file with these institutions applications for the services of the particularly bright and capable. The tuition fees are moderate, and board may be obtained at a reasonably low rate.

SPARKS OF SCIENCE

ABOUT COLOR.

Solar light is a compound substance, consisting of what is termed the seven prismatic colors, namely: red, orange, yellow, green, blue, indigo and violet. These when properly separated comprise the colors of the rainbow, and when combined in a beam, are called white light.

A BEAM OF SUN WAVES.

A beam of waves from the sun is composed of a bundle of ethereal waves, and these waves are of different lengths. The length of a light-wave is the distance from its crest to a similar point on the next wave. The different lengths of waves produce the different colors to our vision. Those productive of red require 39,000, placed end to end, to make the length of an inch, and those productive of violet require about 57,500.

THE COLOR, RED.

When we contemplate the beauty of the color we call red, as we see it in the rainbow, the solar spectrum, in the red leaves of a blooming rose or elsewhere in nature or in art, let us remember that to produce this color, 477,000,000,000,000 of little ethereal waves enter the eye and impinge on the retina in every second of time; and in the same interval 700,000,000,000,000 of these waves enter our eyes, and produce in us the sensation we call violet. When 577,000,000,000,000 impinge on the retina they produce the sensation of green, and the other colors between the red and the violet are all produced in the same manner.

COMPOUNDS OF COLORS.

A compound of red and green will produce white light. Yellow and blue will do the same, and for the same reason, because they are complementary colors.

NO SUBSTANCE HAS NATURAL COLOR.

No substance which we see in nature or art has any natural color. What we popularly term the color of an object is produced, and its color determined, solely by its power of absorption and reflection, and by these qualities alone.

LEAVES OF A TREE OR BLADES OF GRASS.

For this we will instance the leaves on a tree, the green grass, the beautiful flowers. A full sunbeam, with all its elements of color, is showered promiscuously on everything in nature, and the molecular construction of this green leaf, for instance, or of the grass, is such that it absorbs all of the ethereal waves except those of a given length, and these it repels or reflects; the reflected waves, twining back and imping-

ing on the retina of the eye, produce in us the sensation of color, and that color is green. All the other waves are absorbed by the leaf, and produce heat instead of light.

THE PANSY.

The beautiful pansy absorbs all the rays of the solar beam except the shortest ones, that are capable of making themselves sensible to our visual organs, and these short waves are turned back by reflection, and, impinging on the retina of the eye, produce in us the sensation of violet; and so it is through all the range of colors. To repeat, every object in the natural world or the world of art receives the full beam of ethereal waves, or its full beam of colors, which are all the colors of the spectrum or rainbow. It then selects such of these waves, as owing to their length and the position of their planes of vibration, it is unable to absorb, reflects them back to the eye, and the length of these reflected waves determines the color of the object.

The coloring matter that makes the pigment which to us is black, absorbs *all* of the solar beam that falls upon it, and hence no color is reflected back to the eye; on the other hand the white paper on which we write absorbs none of these waves, but reflecting the entire beam back to the eye, we have a compound of all of the colors, and this compound is white; hence we call the paper white. As before said, color is not inherent in anything.

OCEAN CABLES IN WAR TIME

TWELVE CABLES UNDER THE ATLANTIC.

Stretching across the Atlantic bed to-day are twelve cables, ten of them being American and British, two being French, while one German cable has just been completed from the Azores. These cables are as follows: Anglo-American, four cables, from the west of Ireland to Newfoundland; Commercial, three cables, from the west of Ireland to Nova Scotia, but passing Newfoundland in shoal water; direct United States, one cable, from the west of Ireland to Nova Scotia, but passing Newfoundland in shoal water; one French cable, Pougier Quartier, from Brest to St. Pierre, also passing Newfoundland in shoal water; another French cable, Generale, from Brest to Cape Cod; and a German cable, from Emden, via the Azores, to Cape Cod, both passing Newfoundland in shoal water.

THE GERMAN CABLE.

As the German cable runs partly through Portuguese territory, it is regarded as unreliable and practically valueless to England in time of war. There are two cables from Lisbon to Brazil via the Cape Verde Islands, but their connections are complicated, and they are deemed unreliable because of the countries in which their terminals lie. No country at war with England would hesitate to strike at her cables, and would cut them, as well as those of the American companies. If the work were to be done by the American Navy, it would not hesitate to cut the cables owned in this

country, so as to completely sever England's communications with the western hemisphere.

THE FRENCH CABLE FROM BREST.

In the case of France, it is pointed out that a warship at sea might pick up the Brest cable (the location of which is known only to the French officials) and could thereby communicate with the home office, learn if war had been declared, and receive precise instructions, repairing the French cable before departing to sever the enemy's wires.

BRITISH CABLES LANDING AT CORNWALL AND CONNAUGHT.

The British Navy is supposed to be competent to protect the cables landing at the Cornwall and Connaught coasts, while cable cutting in deep water is only possible to experts on regular slow-going cable ships, whose movements would undoubtedly be watched by Great Britain.

CUTTING CABLES IN THE SPANISH-AMERICAN WAR.

Cable experts say that the difficulties met with by the American Navy in cutting cables during the Spanish-American war were the result of inexperience, and that a man who knew his business would, on board a sea-going tug, have all of the Atlantic cables off Cape Canso completely at his mercy, and could finish the job in 48 hours.

POINTS OF LAW

Law is a rule for action established by a government or other competent authority to regulate justice and direct duty. Law may be between God and man either in natural or revealed form; or it may be between man and man. The latter form is divided into several kinds: national or municipal, which may embrace constitutional, cannon or ecclesiastical laws; equity or common law, which embraces what might be called public or criminal laws; and private or civil laws, besides which there is still international law.

CIVIL LAW.

Civil law is the system which the people of a State enact for their welfare. This branch deals particularly with all things not criminal. In that it is private, it has to do with actions between individuals, such as indebtedness, actions on notes, mortgages, etc., the adjustment or acquiring of titles, collections, marriage and divorce, and the like. Branches of the civil law are many, such as commercial law, which has to do principally with business affairs of commercial houses; insurance law, for regulating insurance companies; maritime law, for questions pertaining to affairs of the sea; military law, for armies; municipal law, for cities; sumptuary laws for people dealing in intoxicating liquors, etc.

CRIMINAL LAW.

Criminal law is generally punitive, where civil law exacts only a settlement. The state steps in to inflict a penalty on a malefactor who acts against the good of the public. Criminal carelessness is a crime, though accident is not. If a faulty boiler explodes, or a badly constructed building burns and causes loss of life, some one is liable to punishment for it. Yet a man may accidentally discharge a firearm and

kill some one, and not be held for it.

Ignorance of the law is no excuse.

You may not lawfully condone an offense by receiving back stolen property.

POLICE ARRESTS.

Police are not authorized to make arrests without warrants duly sworn out before a magistrate, unless they personally know that an act has been committed that calls for the arrest.

FORCIBLE ENTRANCE ON WARRANT.

When a warrant has been sworn out for a man accused of crime, his house may be entered forcibly.

EMBEZZLEMENT.

Embezzling is theft by an officer, agent or servant of a corporation.

FELONY.

Felony is a high crime, the highest of the principal classes in which crimes are divided by statute. A grave crime exceeds in grade a misdemeanor.

GRAND AND PETIT LARCENY.

Grand larceny involves over $25; petit larceny anything below that amount.

ARSON.

Arson is the crime of feloniously setting fire to a building.

DRUNKENNESS NO EXCUSE FOR CRIME.

Drunkenness is no legal excuse for committing a crime, but when carried to the extent of delirium tremens, it may be adjudged insanity.

ASSISTANCE COMPULSORY ON POLICEMAN'S APPEAL.

Officers of the law are empowered to appeal for assistance, and anyone to whom they may appeal is in law bound to assist.

FORGERY.

Forgery is the copying or signing the name of another with deceitful or fraudulent intention.

MURDER.

Murder in the first degree must have been premeditated, malicious and willful. Killing in duels is murder.

PERJURY.

Willful false swearing is perjury. A false statement under oath, which is qualified as the belief of the affiant, does not constitute perjury. Subornation of perjury is a felony.

THE HABIT OF BEING LATE

Do people who are prone to be late ever realize the worry they cause to their friends? There are folks in this world who are absolutely punctual in being rigidly behindhand. Some of these make a point of being ten minutes late for everything; others are half an hour late; but they are so regular in their tardiness that it amounts to a mistimed punctuality, and when understood by their friends, can usually be calculated on.

A PUNCTUAL PRINCE.

The present King of England founded his reputation as a leader of polite society when he was Prince of Wales by never being late at an appointment. It is a pity that Americans do not follow his example in this respect, instead of worrying about

the pattern of his or her clothes, as some of them do.

FEW LATE FOR A TRAIN.

It is a notable thing that hardly anyone is late for a train; it is one of the rarest things in the world for a train to be missed. This, in itself, speaks volumes, for does it not show that even the most dilatory of mortals can be in time if they so choose?

A NUISANCE AT THE THEATER.

The same people, however, think nothing of coming into a theater after the play has begun. They will arrive long after the curtain has gone up, talk about programmes, argue as to who shall sit in a certain seat, divest themselves of cloaks and coats, and generally take some minutes to settle themselves down, to the extreme annoyance of all the unfortunate beings around them. Their conduct is quite as disconcerting as that of the wearer of the matinee hat.

LATE FOR DINNER.

There are other people who are always late for dinner, whether at home or at a party. They make no apology whatever. We all know the people who sail in at a large dinner party 20 minutes after everyone else has arrived, and appear quite smiling and thoroughly pleased with themselves. They seem far from realizing that 18 hungry people have been waiting their advent, and that the host and hostess have been in an agony of suspense, for, all entertainers are not wise enough to go to dinner without waiting for such remiss guests. The late comers are quite oblivious of the fact that the culinary department has been watching minute by minute, while a good dinner was spoiling. From 20 to 30 people have been annoyed and upset by the selfishness of these tardy ones, who, quite unruffled, ignore the fact.

Surely, it is quite permissible for the dinner to be served ten minutes after the appointed time, so that those who are courteous enough to arrive at the right hour may not be punished for the heedlessness of others less punctual. If a few more hostesses,—for there are some who do,—showed their sense in this way, lateness would go out of fashion.

It is an odd thing that the people most accustomed to dine out are the most punctual, just as it is that the people who receive the largest number of invitations are the most punctilious in answering them.

A PROBLEM OF 20 INVITATIONS.

Suppose a lady sends out 20 invitations for a dinner party. She may invite six couples; then, four unattended gentlemen and four unattended ladies are needed to make her party complete. Every hostess knows bachelors or maids, widows or grass widows. Some of the invitations will be answered with true courtesy by return post; others will remain unanswered for days. The lady's table will accommodate but 20 guests; she likes to have her full complement; but she cannot ask more than that number, in view of the possibility of some one declining, for, should all accept, the limit of her facilities would be reached.

Now, it is no uncommon thing for the four odd gentlemen to answer, as every one should do, by return post, and for the four odd ladies to withhold their reply for a week. What is the position of the hostess? She is reluctant to invite other gentlemen for fear the original quartette will arrive. If by chance they ultimately decline, the attendance is much curtailed, and she may

not be able to get four equally suitable males, to say nothing of the fact that a delayed invitation is not regarded as complimentary. Many a hostess has been nearly distracted by tardiness of replies to her invitations.

A HOUSE PARTY.

What applies to the dinner party applies to a house party. Every lady in the country who entertains knows the worry and anxiety of arranging for a suitable little coterie of friends, one of whom may disappoint her at the last moment without any proper reason. Entertaining is often a source of real perplexity and discomfort.

THE DOCTOR.

Busy people cannot afford to be tardy in their ordinary business affairs. Take the case of the doctor. He tries with the most punctilious care to keep his appointments; he allots 20 minutes to an old patient or half an hour to a new one, with careful regularity, and if his waiting room becomes full, it is probably because some patient arrived late, or some ailment has taken an unusually long time to diagnose, and thus the whole machinery is put out of gear.

UTILIZATION OF THE EARTH'S INTERIOR HEAT

Judging from present reports, the internal heat of the earth may soon be utilized as a source of industrial power. Along these lines the British Association for the Advancement of Science is making a series of measurements of underground temperatures, and Prof. William Halleck, of Columbia College, New York, says the plan is feasible.

INTENSE HEAT IN DEEP HOLES.

Recently, Prof. Halleck measured the temperature of some of the deep holes in the earth and found that there is a regular rise in temperature for every foot of depth, and in many regions intense heat is encountered at no great distance from the earth's surface. Learned men claim that the moment we obtain such power, the industrial map will be changed.

HOLES A MILE IN DEPTH.

Some holes are 1,000 feet and others one mile in depth. Others are deep wells, which have been sunk in search of gas, oil, water, and even salt, which is found a mile below the surface in Silesia. In Cornwall a zinc mine, 3,000 feet deep, extends out under the bed of the ocean nearly a mile from shore. In fact, men are crawling toward the center of the earth at the rate of several hundred feet a year.

AN ARTIFICIAL HOLE 7,000 FEET DEEP.

The greatest progress thus far has been made at Paruschowitz, in Silesia, where the deepest artificial hole is already 7,000 feet deep, or 400 feet more than a mile and a quarter.

AVERAGE TEMPERATURE 1,000 FEET DOWN, 128 DEGREES.

In this country a comparison has been made of the temperature in the various wells or holes at Pittsburg, Wheeling, Calumet and Houghton, and the average temperature at a depth of one thousand feet was found to be 128 degrees. In France the temperature in the coal mines at a depth of 3,600 fee' is 117 degrees. In short, it is

proved beyond doubt that although it varies in different localities, the heat of the earth grows gradually greater from the surface inward.

EARTH-HEAT MAY BE A UNIVERSAL SOURCE OF POWER.

Upon this Prof. Halleck bases his argument for a new and universal source of power. Preparations are being made at Pittsburg and Wheeling for continued experiments along the line of belief that the earth's heat may be utilized for power, and the near future may contain some unlooked for surprises.

SAVING THE FORESTS

A problem of vital importance presents itself to the American people in the preservation of its forests. For centuries, with the onward march of civilization, has been heard the sound of the ax, hewing away indiscriminately at the mighty trees of the country. While the damage from this onslaught has not been irremediable, nevertheless, some sections of formerly beautiful and valuable country present a sorry sight. The lesson has been learned in many places that the forest lands must be protected.

Several advantages of forest saving are apparent at once. If lumbermen chop away at our noble trees without plan or scientific knowledge, but a few years will pass until serious results will follow. In the first place a constant supply of lumber cannot be insured unless means are taken to prevent the felling of small trees, which are the beginnings of new forests. Without this young growth, future generations will be without lumber.

DISTRIBUTION OF MOISTURE DEPENDENT ON FORESTS.

Inhabitants of sections which were formerly well-wooded and now stand stripped of their timber, have discovered to their sorrow that the irrigation of the soil, even in a fertile country, depends greatly upon the forests. However much the forests may affect the rainfall itself, they have a powerful influence in the distribution of its moisture. The regulation of the flow of streams is mainly insured by forests. The heavy masses of tangled roots and matted leaves of the forest lands collect the moisture, and hold it pent up for a long time.

FORESTS PREVENT FLOODS AND DROUTH.

This prevents great floods during spring thaws, and, conversely, prevents seasons of drouth by allowing this stored up water gradually to find its way to the brooks and rivers. Thus, streams valuable for water power are preserved in their natural volume, and economic purposes are subserved. Compare the wildly-rushing, muddy-stream, rolling in the spring through timber-stripped country, and the same stream dry, in the season when moisture is most needed in its valley for crop maturing, with that stream whose current is still regulated by kindly forests. This comparison has gradually become so effective that much good is resulting from it.

LESSEN THE NECESSITY FOR IRRIGATION.

As the tide of improvements moves further westward, the problem of developing

arid and waste lands is being studied more closely. In the great deserts, scientific irrigation is already turning desolation into a paradise. Agriculture in the West depends more and more upon the forests. In many sections moisture depends upon storage reservoirs. These often give way through the breaking of dams. This can be obviated, but many others are stopped up with silt. This latter evil has only one remedy, the forest. Even the irrigation ditches receive their water from streams whose sources are in great forest reserves. When it is considered that there are in this country nearly one hundred million acres of land, not yet under cultivation, which may be reclaimed by irrigation, and that this land will support twenty million souls, the possible benefit from the preservation of forests may be imagined.

NATIONAL FOREST RESERVES.

The United States Government has taken a hand in this great work, congress having passed an act March 3, 1891, establishing national forest reserves. From President Harrison down, each successive executive has designated many acres of forest land to be set aside. In some instances in the West, these reserves constitute the greater part of the whole territory of the State. In the whole United States there still remain nearly 1,000,000 square miles of timber land. Under the careful direction of the General Land Office, the United States Geological Survey and the Division of Forestry of the United States Department of Agriculture, much may be done with this timber.

There has been something of a hue and cry, due largely to selfish interests, against the establishing of the reservations. On some of the great public lands, sheep-grazing is an important and valuable industry. These sheep often stray through the forests in huge droves, trampling down the young tree growth and hardening the soil. Ruin to the woodland often follows, and that in itself would prevent further grazing. But the sheep herders overlooked this feature and fought against the reserves, fearing the exclusion of their sheep. When the true value of preserving the timber land was understood, and it became known that sheep could be grazed in small herds, the movement progressed rapidly.

DESTRUCTION OF FORESTS BY FIRE.

Fire alone, it is estimated, causes a loss of $50,000,000 a year to forests. In thickly timbered country this is little thought of, for what is plentiful is regarded cheaply. But the tremendous economical importance of this great national resource is being brought home to the many. In such States as are made up of treeless plains, timber must be had for building, else the onward march of civilization will cease.

THE RAINFALL AND DISTRIBUTION OF FORESTS.

The distribution of forests in general corresponds with that of rainfalls. The Pacific coast has perhaps the finest and heaviest timber in the world. It is not the oldest States that have the smallest forests. Those that border on the Atlantic coast, with the exception of one, have a wooded area of more than 36 per cent of their entire territory. Louisiana has 62 per cent; Alabama, 74 per cent, and Texas, 24 per cent; about two-thirds of the surface of the Gulf States (except Texas) is covered with timber. Iowa has only about 13 per cent, while North and South Dakota fall to 1 and 3 per

cent, respectively. Nebraska has 3 per cent, and Kansas 7 per cent. These smaller yields are on the treeless plains. Toward the Rocky Mountains the timber grows heavier, and no States west of them have less than 10 per cent of woodland.

THE WORLD'S WATER POWER

Of recent years there has been great progress in the development of power from waterfalls. If the wasted waterfalls of the world were put to use driving electrical dynamos, sufficient power would be generated to supply the mechanical needs of the whole world. This fact has been recognized and a movement is now on foot in every direction to harness the wasted power.

NIAGARA FALLS.

Probably the greatest example of waterfall power is that at Niagara Falls. The chaining of the power of this great cataract is one of the most marvelous feats of mechanical engineering ever accomplished. A little more than ten years ago ground was broken for a tunnel which was to convey the waste water of the falls. To-day this same waste power generates more electricity than is produced under any other single roof in the world.

A GREAT POWER-HOUSE.

This great power house is over 450 feet long, the main portion of it covering a wheel-pit 179 feet deep and 19 feet wide. Near the bottom of this pit are 10 turbines, each of 5,000 horse power, and each connected by a steel tube 166 feet long to a generator in the power house above. Each generator is capable of developing 5,000 horse power; thus the plant has 50,000 horse power. The water which furnishes this power is carried by means of a canal that taps the Niagara River one mile above the falls. The normal depth of the water in this canal is 12 feet. From it the water is led by penstocks directly to the wheel pit, and as it rushes upward it turns the turbines. After having performed its work, the water passes through a tunnel or tail-race built 200 feet below Niagara Falls and empties into the lower river. This tunnel is lined with brick from end to end.

A GREATER POWER-HOUSE.

Another power house with a capacity of developing 55,000 horse power is also fed by this tunnel. A second wheel pit with eleven turbines has been constructed, thus generating 105,000 horse power at this station from the formerly wasted water power of Niagara Falls.

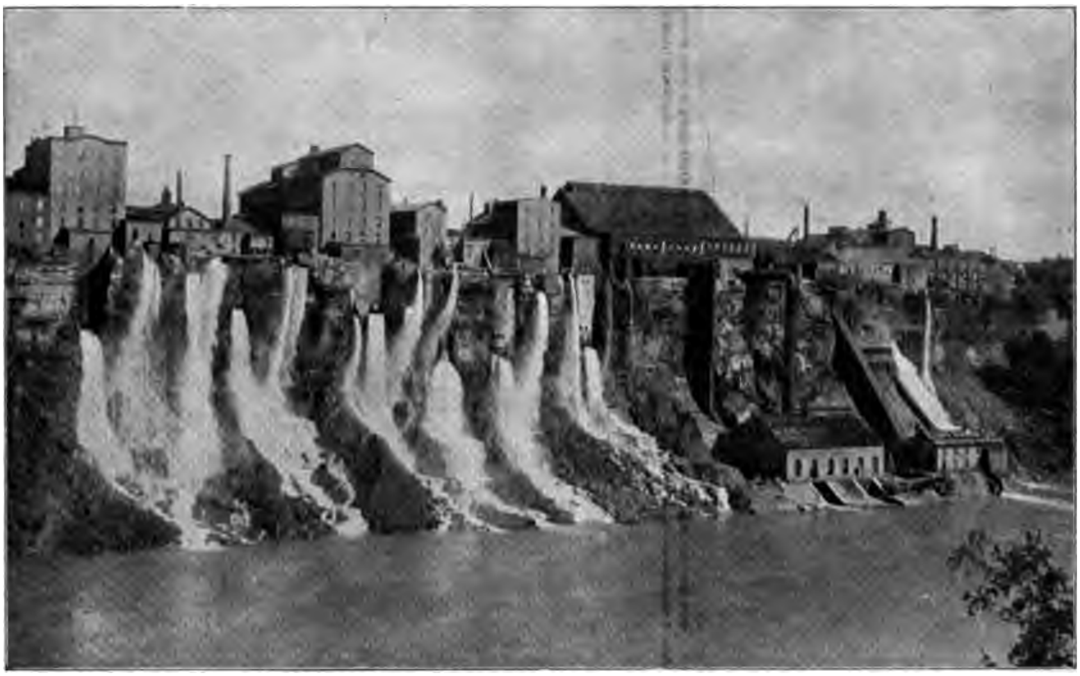
VARIOUS USES FOR THE POWER THUS DEVELOPED.

The electricity thus developed is put to many uses. Formerly it was intended only to serve the city of Buffalo with power. This, however, proved a very small portion of the work that devolved upon the plant. The Pan-American Exposition at Buffalo was furnished with electricity for its marvelous electrical exhibits. Thus, no matter how beautiful or potent the effect of the presence of the electrical power at the exposition, trace it as one might, the source of the energy was found miles and miles away down at Niagara Falls, where, day and night, through all the season, the mighty turbines and mammoth generators

were swirling at the rate of 250 revolutions per minute. To impress more fully the magic power of the falls it may be said it could not be duplicated if 600,000 men performed the hardest kind of physical labor. Yet the great current there flows on forever.

A NEW CITY.

Moreover, the supplying of light to Buffalo and nearby towns and to the Exposition was merely a phase of the early work of this great power plant. Around the falls has grown up a veritable city, with heat of marvelous intensity, and by the means of electrical furnaces in the neighborhood, a new substance called carborundum is manufactured. This substance is as hard as a diamond, and is used for abrasive purposes, displacing emery wheels, etc. Great quantities of this cheap electric current are also used to reduce copper by the process of electrolysis, and a similar principle follows in the production of bleaching powders, aluminum, and many other things which are making Niagara Falls famous.



By courtesy of the Detroit Photographic Co.

SOME OF THE GREAT MILLS THAT USE NIAGARA'S POWER.

industries which derive their power from this current. Many of these industries depend upon processes in which chemical action is the chief factor. It would be nothing uncommon to run a cotton mill by this power, for it would be simply a substitute for steam. But this tremendous power of electricity enables the development of a

SENDING WATER POWER OVER LONG DISTANCES.

Great power is also being developed from waste water at other places. Some of the most remarkable examples of sending power over long distances are found in the Western States. Late improvements have resulted in transmitting a current 150 miles

across the Rocky Mountains. Many cases are on record where pipe lines and flumes wind in and out through the mountains for many miles, gathering up waste water which finally plunges over turbines to develop electricity. By this method fuel, which formerly had to be packed zig-zag across the mountains on the backs of burros, at a heavy expense, is dispensed with.

Work in the mountain mines thus can go on night and day in winter as well as summer.

POWER GENERATED BY CANON WATER.

Near Salt Lake City power is generated by canon water, which passes from one power house to another, and after operating goes on down to a third house.

POWER FROM THE AMERICAN RIVER.

Sacramento has power for its light and its trolley cars generated by the American River 20 miles away. Many other cities in the West get heavy currents at long distances, creeks being harnessed for this purpose. Rapids in many streams bring forth great power. Foreign companies have taken up the method, and send thousands of horse power many miles.

ELECTRICITY FOR SAN FRANCISCO GENERATED 152 MILES AWAY.

San Francisco is served with electricity generated in the Blue Lake region in California, 152 miles away. The waters of the Yuba River supply a current to Oakland, California, 145 miles away.

VICTORIA FALLS.

Victoria Falls, in Central Africa, will sometime be harnessed and experts say that enough power could be transmitted to run all the machinery in the gold mines for the next twenty years.

THE STUDY OF OTHER WORLDS

PIAZZI SEARCHING THE HEAVENS.

Although astronomy is at once the most beautiful and the most exact of the sciences, yet so little is really known of the limitless realms of the air, and so great are the possibilities for discovery, that scientists are constantly at work searching the heavens to solve their great mysteries.

IMMEASURABLE SPACE.

Most startling of the things to consider in the study of the starry sky is its immeasurable space. The earth, we know, is only one seemingly infinitesimal speck in the harmony of the universe. Millions upon millions of stars are traveling throughout space in some direction. Our solar system with its sun for a center, and its planets, stars and satellites, is not the only one thus in motion.

These systems, like the sun's, seem shoot-

ing off wildly into space, but who knows whether, centuries upon centuries from now, these seemingly wild flights may not shape themselves into orbits, similar to that of the earth. Perhaps, in the end of all things, these worlds that go careering along in space may all unite, gathering size as they go, and eventually all burning up and leaving a black and starless sky. When we know that the stellar bodies are traveling in all directions, some of them at the frightful speed of 200 miles a second, we wonder what will be the outcome.

A CLEVER ILLUSTRATION.

We are amazed at the immensity of space. One well known astronomer has used a very clever illustration to indicate the size of the universe. He describes all known space as about the size of the United States. Upon this he lays an ordinary lady's finger ring, as the comparative extent of the earth's orbit. An actual mile away from the ring, he states as the comparative distance of the first fixed star. The constellation of Lyra is about ten miles from the ring, flying along at the rate of three hundred million miles a year, and all the space from the Atlantic ocean to the Mississippi river is filled with constellations, stars and planets. What wonder that even the mind of the scientist is awe-stricken.

PROBLEMS NOT YET SOLVED.

While we are wondering at the immensity of the universe, we are carried along into other problems which as yet the scientists have not solved. We know that friction causes heat. We see this in the combustion of the shooting stars, which we know do not start out on their journeys already on fire, but are heated and burned up because of the friction of the atmosphere, as they tear along through the skies. If we can see this in the few stars that shoot to earth, how many are there that we do not see, and what immense heat is derived from this great friction of the stellar bodies? We know or think we know that such glowing bodies as the sun are combustible, because of the contraction of their parts by gravitation. Perhaps all bodies are contracting and throwing off some heat. Where then does all the heat go? What becomes of the light also that has flown from the myriads of stars since the creation? We know that light flies at the rate of 180,000 miles a second. Can it be possible that in the millions of years since the earth began its formation, the light that first went off from the first sun has not reached the confines of space?

PLANETS VISIBLE TO THE NAKED EYE.

If these questions perplex us, what are we to say of the stars and planets which we can see with the naked eye? Is Mars inhabited? Does Venus have an atmosphere like that of our earth? What of the moon, so close to us that we think we can distinguish craters of worn-out volcanoes, and the dry beds of old rivers and oceans? What of the spots on the sun, — what causes them, — what is the corona about this body, and why does the sun seem so calm when it is a raging furnace?

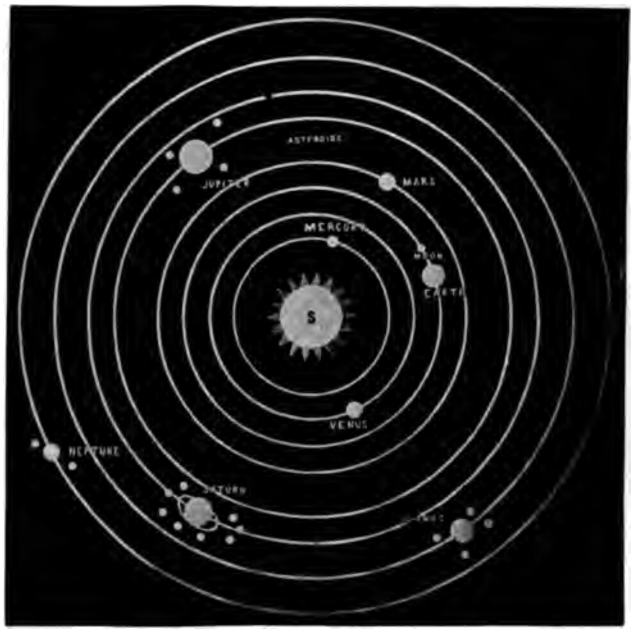
THE COPERNICAN SYSTEM.

But while we leave astronomers to delve into the mysteries that remain, let us look into some of the things that we have learned concerning this science. The system of astronomy as now accepted is called the Copernican system, after Nicholas Kopernik, or Copernicus, who, in 1543, breaking away from the ideas of the scientists that

preceded him, revived those of Pythagoras. He saw the beautiful simplicity of considering the sun the grand center about which revolve the earth and all the planets. He noticed how constantly, when we are riding swiftly, we forget our motion, and think that objects really stationary are gliding by us in the contrary direction. He applied this thought to the movements of the heavenly bodies, and maintained that, instead of the stars revolving around the earth every 24 hours, the earth simply turns on its axis; that this produces the apparent daily revolution of the sun and stars, while the yearly motion of the earth about the sun, transferred in the same manner to that body, would account for its various movements.

KEPLER AND THE TIDES.

Then came Kepler, who adopted the Copernican theory, and whose observations upon the planet Mars cleared away many complications. He also remarked that gravity was a power existing between all bodies, and reasoned upon the tides being caused by the attraction of the moon for the waters. About this time, namely, the beginning of the seventeenth century, the telescope was invented and logarithms came into use.



THE SOLAR SYSTEM.
Plan showing the Movements of Planets around the Sun.

GALILEO AND THE TELESCOPE.

Galileo, who had discovered the laws of the pendulum and of falling bodies, learned that a Dutch watchmaker had invented a contrivance for making distant objects appear near. With his profound knowledge of optics and philosophical instruments, he instantly caught the idea, and soon had a telescope made that would enlarge things 30 times.

With this telescope he looked at the moon, discovered its valleys and mountains, and watched the heavy shadows sweep over its plains. Near Jupiter he saw three bright stars, as he considered them, which were invisible to the naked eye. Shortly after, he noticed those stars had changed their relative positions. Somewhat perplexed, he waited three days for a fair night in which to resume his observations. When he looked again the stars had shifted. After much observation he discovered a fourth star, and finally found that they were all rapidly revolving around Jupiter, each in its elliptical orbit, with its own rate of motion, and all accompanying the planet in its journey around the sun.

Here was a miniature Copernican system hung up in the sky for all to observe for themselves.

Galileo met with the most bitter opposition. A great many refused to look through the telescope, lest they might become the victims of the philosopher's magic. Some prated of the wickedness of digging out valleys in the fair face of the moon, while others doggedly clung to the theory they had held from their youth up.

NEWTON AND GRAVITATION.

Then Newton promulgated his immortal discovery of the law of gravitation. Subsequent researches brought astronomy into prominence more and more. The spectroscope has revealed elements existing in the vapors and compositions of the sun and of the heavenly bodies. Stars are now known to be suns, some bearing a great resemblance to our sun, and others differing materially.

ASTRONOMICAL INSTRUMENTS.

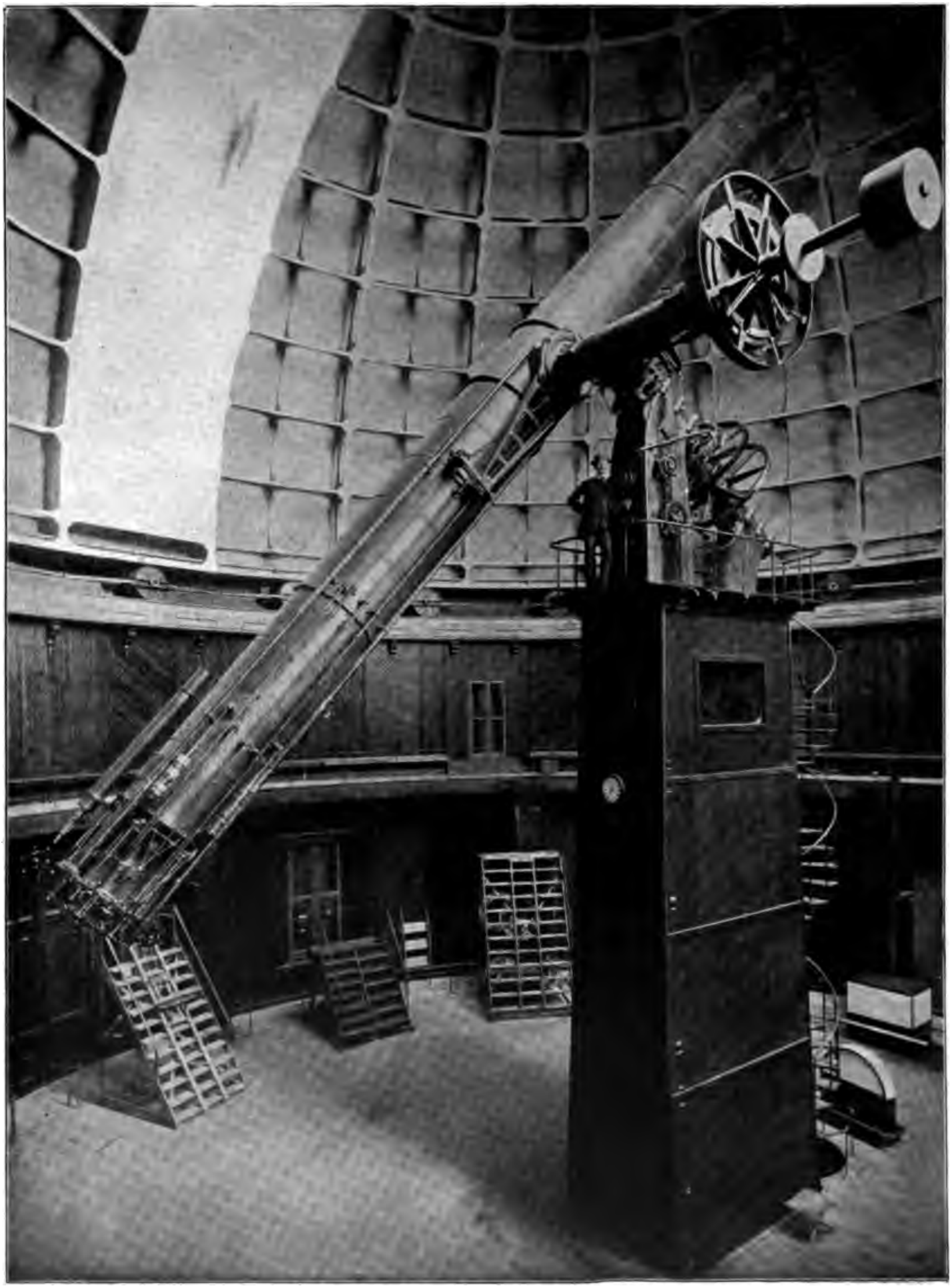
Instruments for astronomical observation have now been brought to a pitch of perfection scarcely ever dreamed of, and month by month discoveries are made and recorded, while calculations as to certain combinations can be made with almost miraculous accuracy. The transit of Venus, the approaches of comets, eclipses, and the movements of stars are now known precisely, and commented on long before the events can take place.

GREATEST TELESCOPE IN THE WORLD.

And here it might be well to describe the greatest telescope in the world. This instrument is known as the Yerkes telescope, and is located in the observatory of the astronomical department of the University of Chicago, on the shores of Lake Geneva, Wisconsin. Its huge 40-inch refracting lens is the largest in existence. Probably larger ones will not be made, because of lack of distinct vision, and because the great steel tubes which hold the lens would be likely to sag out of shape. The large glasses of the lenses were ground by Alvin Clark. The glass, proper, is made up of two lenses, one of flint glass and the other of crown glass, ranging in thickness from 3/4 of an inch to 2 inches, and poised 8 inches apart. Clark was engaged four years in polishing

THE LICK OBSERVATORY.
As Seen at a Distance.

them and the last touches were done by his finger tips. The glasses weigh 500 pounds. Contrary to general opinion, small scratches and dust do not prevent clear vision through this glass and no protection is placed over it.



36-INCH TELESCOPE,
At the Lick Observatory.

ITS MAMMOTH TUBE.

The great tube of the telescope weighs 20 tons and is 65 feet long, yet so delicate is the mechanism, so perfect are the motors, and so carefully poised is the instrument, that it can be adjusted instantly. This monster eye is housed under a 90-foot dome, beneath which is a large floor, weighing 40 tons, which by means of electrical motors, can be lifted to a height even with the eye-piece of the telescope. The dome is also movable on a circular track, so that at the will of the operator the telescope may be trained through a great opening in the dome, upon any quarter of the heavens. Within the base of the telescope is a clock-work arrangement which keeps the tube moving steadily in the path of the star under study, as well as adjusting its workings. This telescope cost, together with the observatory, a half million dollars.

With this remarkable instrument, it has been learned that a layer of carbon surrounds the sun, a thing hitherto unknown. By means of spider-webs drawn across the eye-piece of this instrument, the fifth satellite has been measured. Very good photographs of the moon have been made, and it has been learned that some of the heat from the stars reaches the earth.

WORKINGS OF THE TELESCOPE.

The workings of the telescope are very interesting. In making measurements of stars, spider-webs are used. Spiders are kept for the purpose of spinning threads and the webs are strung in boxes arranged like lantern slides across the eye-piece. Distances have already been computed between the stars. Knowing the distance between the web and the stars, when the shadow of the star appears upon the webs, the size of the former can be ascertained. These webs are also used to catch the lights and colors of the stars, so that astronomers, knowing that certain minerals burn with a certain color, may classify the makeup of the stars. The telescope is arranged very aptly for taking photographs. A light shutter is placed at the end nearest the sky, and the photographic plate is put at the eye-piece.

THE SOLAR SYSTEM.

The solar system consists of the sun, the center; the major planets, Vulcan (undetermined), Mercury, Venus, the Earth, Mars, Jupiter, Saturn, Uranus, Neptune, the asteroids, or minor planets, the satellites or moons, which revolve around the several planets; meteors, shooting stars and comets. The stars called planets have certain motions, going from East to West, from West to East, and sometimes again appearing quite motionless. This change of place from one side of the sun to another, has given them their title of "wanderers." The planets and their satellites, the asteroids, comets and meteors, all circle around the sun in more or less regular orbits. There must also be families of comets that have not yet appeared to us, and whole systems of meteors as yet unseen.

THE SUN.

The sun is not solid, so far as we can tell. It is apparently a mass of white, hot vapor, and is enabled to shine by reason of its own light, which the planets and stars cannot do. They shine only by the sun's reflected light. We might therefore conclude that the sun is all gas, but through recent study by the spectrum, scientists have discovered that a number of elements exist in the sun in a vaporous state. Hydrogen is there, with other gases unknown to us,

and many metals. The sun is supposed to be spherical in shape, not flattened at the poles as our earth is, and to be composed of materials similar to those which constitute the earth, only that in the sun these materials are still in a heated condition.

ITS SIZE AND DISTANCE FROM THE EARTH.

The sun's average distance from the earth is 91,500,000 miles. The volume of the sun is 1,253,000 times that of the earth, but its density is only about one-fourth that of the earth. The attraction of gravitation at the sun must be 27 times more than that of the earth's surface. A body dropped near the surface of the sun would fall 436 feet in the first second, and would then attain a velocity of ten miles a minute.

ITS LIGHT.

The light of the sun is equal to 5,563 wax candles held at a distance of one foot from the eye. It would require 800,000 full moons to produce a day as brilliant as one of cloudless sunshine. The amount of heat we receive annually is sufficient to melt a layer of ice 38 yards in thickness, extending over the whole earth. Sun spots, as they are generally called, are hollows in the sun's vapory substance, and are of enormous extent, and there are brilliant places near those spots, which are termed faculæ. These spots have been observed to be changing continuously, and passing from East to West across the sun, and then appearing again at the East, to go over the same space again. This fact has proved that the sun turns around upon its axis. Although it does not move, as we imagine, from East to West, around the earth, it does move. In fact, the sun has three motions: one on its axis, a motion about the center of gravity of the solar system, and a progressive movement toward the constellation Hercules.

NUMBER OF THE PLANETS.

The ancients knew five of the planets, and named them Mercury, Venus, Mars, Jupiter and Saturn. In later years a great number were discovered, but the principal ones are eight in number, including our own earth, Uranus and Neptune. All the planets are spheroids and vary greatly in size. Comparing their size and magnitude, Sir John Herschel said: "Choose any well-leveled field, and on it place a globe two feet in diameter to represent the sun. Mercury will be represented by a grain of mustard seed on the circumference, with an orbit 164 feet in diameter; Venus is represented by a pea, in a circle 284 feet in diameter; the earth also by a pea, in a circle of 430 feet; Mars, a rather large pin's head, in a circle of 654 feet; Juno, Ceres, Vesta and Pallas, grains of sand in orbits of 1,000 to 1,200 feet; Jupiter, a moderate sized orange, in a circle nearly half a mile across; Saturn, a small orange, in a circle four-fifths of a mile across, and Uranus, a full-sized cherry, or small plum, upon the circumference, more than a mile and a half in diameter."

MERCURY.

The distance of Mercury from the sun is less than half that of our earth, and so it receives much more heat and light than do we. The sun viewed from that planet, if such a thing were possible, would appear seven times larger than from the earth. Mercury's orbit is the most eccentric of any of the eight principal planets, so that, although when in perihelion it approaches to within 28,000,000 miles, in aphelion, it

speeds away 15,000,000 miles further, or to the distance of 43,000,000 miles. Being so near the sun, its motion in its orbit is correspondingly rapid—30 miles a second.

VENUS.

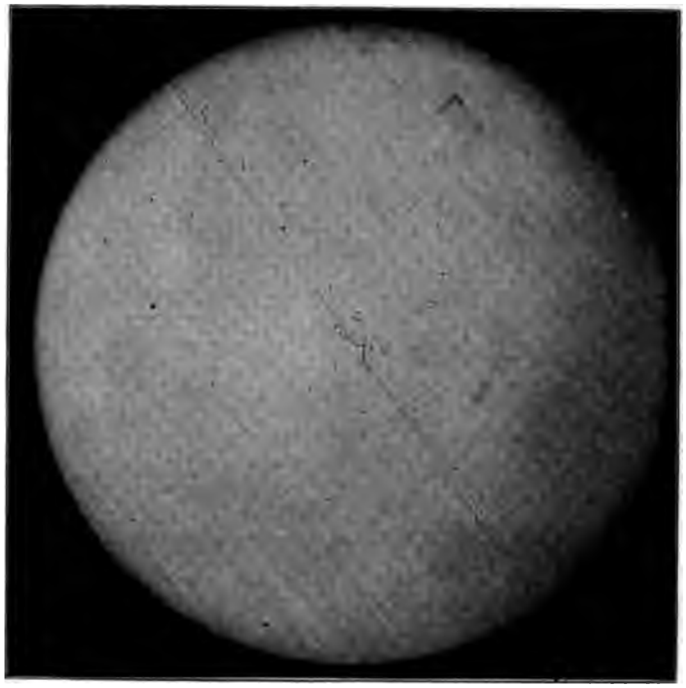
Venus, the nearest planet to the earth, is somewhat smaller than our globe. It is both a morning and an evening star, and shines with great brilliancy. It can scarcely be doubted that Venus is surrounded by an atmosphere denser than our own. The observations made during successive transits seem to have established the fact that aqueous vapor exists around Venus and that water exists in it.

THE EARTH.

It seems rather strange to class our earth, which is dark and opaque, and which appears to us so vast, among the bright heavenly bodies. Nevertheless, it is one of the smallest of the principal planets of the solar system, and although we see in it no motion, while the orbs about us seem constantly changing their positions, science has shown that the earth revolves around the sun in an orbit of nearly 600,000,000 miles, at the tremendous rate of 18 miles a second, or 65,000 miles an hour. To other worlds our earth appears as a star does to us. In studying astronomy we must consider that it is a planet shining brightly in the heavens, held in its course by the invisible power of gravitation, and that in reality it is small and insignificant beside some of the mighty spheres that so gently shine upon us from distances almost inconceivable. Our earth, in fact, is only one atom in a universe of worlds, all firm and solid, and all, perhaps, equally well fitted to be the abode of human beings and animals.

THE MOON.

The moon is the satellite of the earth. "Fancy," says Lockyer, "a world without ice, cloud, rain or snow; without rivers or streams, and therefore, without vegetation to support animal life; a world without twilight, or any gradations between the fiercest sunshine and the blackest night; a world also without sound, for, as sound is carried by the air, the highest mountain on the airless moon might be riven by an earthquake inaudibly."



TRANSIT OF VENUS.

ITS DIAMETER, AND DISTANCE FROM THE EARTH.

The diameter of the moon is about 2,160 miles, and it is much less dense than our earth; therefore the force of gravity is less there than here. Its mean distance from us is 238,833 miles. It goes through certain changes or phases about every 29 days, and while rotating on its own axis, it goes around the earth, so that we can see only one side of the moon, inasmuch as the two motions occupy almost exactly the same length of time. Thus we generally see the same space of the moon, though at times there is a slight variation. The moon passes the sun periodically, and so if she moved in the plane of the ecliptic, there would be eclipses of the sun and moon twice a month. But as the orbit is inclined somewhat, the moon escapes by moving north or south.

ECLIPSES.

There are eclipses of the sun and of the moon. The former occur at the time of the new moon and the latter at full moon. This can be understood readily when we remember that the sun is eclipsed by the moon passing between us and the sun. The moon is eclipsed because the shadow of the earth falls upon her when it is opposite the sun, and therefore "full."

NORTHERN LIGHTS.

EBB AND FLOW OF THE TIDES.

The ebb and flow of tidal water depend upon the moon to a great extent. Twice every day we have the tides, twelve hours apart, and the flow and ebb are merely examples of the attraction of gravitation,

which is exercised on all bodies, whether liquid or solid.

MARS.

Mars appears to the naked eye as a bright red star, rarely scintillating and among all nations. The Jews called it "blazing," and it bore in other languages a similar name. The orbit of this planet is exterior to the earth's, as is proved by it never appearing "horned" nor ever pass-

By courtesy of Allen L. Cotton.
THE MOON—FROM A PHOTOGRAPH TAKEN AT THE LICK OBSERVATORY.

shining with a steady light which distinguishes it from the fixed stars. Its ruddy appearance has led to its being celebrated ing across the sun's disk. Therefore, no transits of Mars can take place as do transits of Venus and Mercury. **Mars is most**

like the earth of all the planets. There appears to be a white or snowy region near its poles at varying periods, which would lead us to the conclusion that the changes of atmosphere and the seasons are similar to our own; and as the inclination of the planet is nearly the same as that of the earth, this supposition may be accepted as a fact. Mars is attended by two satellites, or moons, discovered in 1877, both very small.

JUPITER.

Jupiter is called the giant planet, and is 1,300 times larger than the earth. Its mean diameter is 86,500 miles, with 270,000 miles' circumference. Its inclination is very small, and therefore the changes of seasons are very slight. It has four satellites. These moons act, with respect to Jupiter, very much as the latter acts with respect to the sun. Jupiter is the largest of the planets, and only Venus is brighter. It revolves at a distance of 476,000,000 miles from the sun and 390,000,000 miles from the earth, and its year is equal to nearly twelve of ours, while its day is scarcely ten hours long, showing a rapidity of motion more than 20 times that of the earth.

ITS SUNLIGHT AND HEAT—DAYS AND NIGHTS.

There is much less sunlight and heat on Jupiter than upon the earth, because it is so much farther away from the sun.

There is but little difference in the length of the days and nights there, which are each of about five hours' duration. At the poles, the sun is visible for nearly six years, and then remains set for the same period.

SATURN.

Saturn is a great globe surrounded by a beautiful bright ring or series of rings, and attended by eight satellites. It appears to have much the same constitution as Jupiter, but is enveloped in an atmosphere even denser. It revolves on an inclined axis and has seasons unequal in length.

ITS RINGS.

The rings of this planet are apparently broad, flat and thin, resembling roughly the horizon of the globe, and are supposed to be a close agglomeration of stars or satellites, revolving around the planet and encircling it in a belt. The two outermost rings are very bright, the inner ring being darker and partially transparent, for the ball of Saturn can be perceived through it. Saturn, on account of its distance, shines with a feeble, pale, yellow light, which is steady and distinguishes it from the fixed stars.

ITS ORBIT.

Its orbit is so vast that its movements among the constellations may be traced readily through one's lifetime. It takes two years and a half to pass through a single sign of the zodiac; hence when once known, it may be found easily again. As the earth and Saturn occupy different portions of their orbit, the distances between them at different times may vary 200,000,000 miles.

URANUS.

Uranus was discovered by Herschel in 1781. It revolves at an enormous distance from the sun, namely, 1,753,000,000 miles. It takes about 84 of our years to go around the sun, and it possesses four moons. It is about four times larger than the earth in diameter, and about 40 times in volume. We can only speculate concerning its physical constitution, which is assumed to be similar to that of Jupiter, while the changes of

temperature and seasons must vary immensely.

NEPTUNE.

Neptune is the far-off sentinel at the very outposts of the solar system. The existence of this planet was determined by calculation before it had been seen at all. Uranus was observed to be disturbed in its orbit, moving sometimes faster than at other times, and even before Uranus had been discovered, Saturn and Jupiter had been seen to be affected by some other body in the system. Very little can be said concerning this planet, as its distance is too great for good observation. It has one moon, which moves about the planet in five days and 21 hours, and is of great size.

THE ASTEROIDS.

The asteroids are smaller planets circulating outside the orbit of Mars. They are all at distances from the sun ranging between 200,000,000 and 300,000,000 miles, the periods of sidereal revolution ranging from 1,100 to 3,000 days. Consequently their years are from three to nine times as long as ours. Nearly 250 of these minor planets have been discovered. They are all very much smaller than the earth.

METEORS.

Meteors are small, erratic bodies, rushing through the planetary system and getting hot in the process. They appear in the atmosphere surrounding our earth as "shooting stars." Some of these falling bodies have reached the earth. Such are called aërolites, or meteorites. Numbers, of course, are burned up before they reach us. They are of a metallic nature. On certain nights of August and November, it has been calculated that these meteors will appear. They fall from certain constellations, after which they are named, as Leonidas, from Leo, in the November displays. The star showers sometimes present the appearance of a beautiful display of rockets. Millions of them rush around the sun.

COMETS.

It has been lately suggested that there is a great degree of affinity between comets and meteors, in fact, that a comet is merely an aggregation of meteors. Comets have been supposed to be bodies of burning gas. Their mass is very great and their brilliant tails are many millions of miles in extent. In their orbits they differ greatly from the planets. While the latter are direct in their wanderings, comets are more irregular and eccentric. When first seen, the comet resembles a faint spot of light upon the dark background of the sky. As it comes nearer, the brightness increases and the tail begins to show itself. The term comet signifies a hairy body. A comet consists usually of three parts, the nucleus, a bright point in the center of the head, the coma, a cloud-like mass surounding the nucleus, and the tail, which is a luminous train extending generally in a direction from the sun. It is not understood whether comets shine by their own or by reflected light.

THE FIXED STARS.

The fixed stars are those which apparently remain immovable and shine with a shifting, twinkling light, although it is known now that they also are in motion. The number of the stars is beyond our calculation. Those visible only in the telescope amount to millions. The stars visible to the unaided eye are about 6,000, in number. There are more visible in the southern than in the northern hemispheres.

THE NEBULAR THEORY.

The nebular hypothesis was put forward by Laplace, and by it he attempted to account for the stellar system, which is supposed to have originated from an immense nebular cloud. This immense mass would rotate and contract and the outer portions would separate and develop into rings, like Saturn's rings. Then the rings would break into separate portions, each portion condensing into a planet, or the small "bits" would travel around the sun like asteroids, and in this manner various systems would be formed.

THE MILKY WAY.

The "milky way" is a whitish, vapory-looking belt, and is composed of multitudes of millions of suns, of which our own sun, itself, is one. They are so far removed from us that their light mingles and makes only a fleecy whiteness. An actual knowledge of the milky way is still beyond us. It is agreed, however, that the galaxy is not a continuous stream, but a series of luminous patches, great aggregations of stars illimitable in numbers, and independent of each other.

LABOR UNIONS AND ARBITRATION

The wisest and most substantial men of affairs have but recently realized what organized labor has learned, and what has been its marvelous progress, and they have profited thereby.

STRENGTH OF THE UNIONS—DOUBLED IN FOURTEEN YEARS.

This advance in the labor movement is shown by a doubling of the membership of the unions since 1899, and a strengthening of their sense of responsibility. The best token of the latter change is seen in the numerous conferences and agreements now common between organized capital and organized labor.

THE DEMAND FOR RECOGNITION OF THE UNION.

The demand most urgently presented by labor in the event of a controversy is that of recognition of the union. Capital is prone to reply to such a demand that it is meddling with matters of individual business, in which labor is entitled to no voice.

THE ANTHRACITE COAL STRIKE OF 1902.

A well known instance of this demand and response was a feature of the anthracite coal strike of 1902. This strike caused nearly $200,000,000 of loss to mines and miners.

PRESIDENT ROOSEVELT'S ARBITRATION PLAN.

President Roosevelt brought to bear a power that resulted in arbitration and showed that all this expense and misery could have been prevented.

CONSERVATIVE LABOR LEADERS AVERSE TO STRIKES.

Strikes are now commonly deprecated by the more conservative unions as bad, and as justifiable only in extremities. No longer do unionists cry against new machinery. Gradually scales of wages are being regulated by concessions on both sides. Sympathetic strikes, even in extreme cases, are less often countenanced than formerly. Public opinion has tended to modify the unions'

insistence that non-unionists be excluded from employment with their members, and most labor leaders are crying out against violence. It can be stated truthfully that, in the majority of instances where riots accompany strikes, the assaults are committed by other than union men.

LOCAL BOARDS OF ARBITRATION.

So dangerous to the common good are strikes and labor difficulties which tie up industry that legislatures and public spirited bodies on all sides have appointed boards of arbitration to settle disagreements.

ESSENTIAL QUALITIES OF THE SAFE LABOR LEADER OF TO-DAY.

While many of the labor leaders in times past have been mere agitators, the time has now come when the man who stands at the head of a great labor organization must be a man known for wisdom, integrity and strength of purpose.

There will be a feeling that unions are not responsible just so long as good men do not lead them. Many strikes have been needless and have resulted in no good. This has been due largely to poor leadership. There has been a constant strife between capital and labor, an extraordinarily destructive one, and labor demands the best brains and absolute honesty in the men who direct its counsels. This only will wear down the prejudice against it, brought about by the traffic of dishonest demagogues. Such a man as the late P. M. Arthur furnished the true ideal of a union leader whose guidance was beneficent.

STATISTICS OF THE DEPARTMENT OF LABOR.

Statistics of the Department of Labor will show the terrible expense caused by labor disturbances in 15½ years from January 1, 1881. The open struggles cost more than $285,000,000 and threw 3,714,406 persons out of employment by reason of strikes. Each striker lost on an average $44, and 366,690 persons lost an average of $73 each by lockouts. Of the total loss of $285,000,000, two-thirds was borne by the employes and one-third by the employers.

The losses in the anthracite coal strike of 1902 are appalling. The strike lasted over five months, during which time 183,500 miners and others were thrown out of work, and 105,000 women and 285,000 children were involved in suffering. Capital amounting to $511,500,000 invested in the mines lay idle without return.

The mine owners daily lost, in price of coal they could have mined, $443,500. The loss in miners' wages was about $30,000,000, the loss to operators $69,000,000; that to merchants in mining towns, $23,000,000. The loss to mills and factories closed for lack of fuel was over $7,000,000; that to merchants in outside districts, $16,000,000; to railway lines, $34,000,000; the loss of business permanently abandoned amounted to $8,000,000; the cost of troops in the field was nearly $2,000,000; the cost of police to patrol the mines was $3,500,000; the amount lost in railway men's wages was $275,000; the cost of keeping and protecting non-union workers at the mines amounted to $545,000; the damage to mines and machinery by fire and by the flooding of mines was about $5,000,000. The total cost of this one disastrous strike in money alone was about $200,000,000. And this cannot account for the lives lost in the riots.

PROPORTION OF SUCCESSFUL AND UNSUCCESSFUL STRIKES.

In most cases a strike causes only bitterness on both sides. Forty-four per cent of

strikes succeed, the same number fail, and the other 12 per cent are "draws."

LABOR'S GAINS.

In the whole course of strikes the employes have gained considerable advantage in wages and hours; but wisdom is now leading men away from this means of adjusting grievances and beckoning them toward peaceful agreement and arbitration.

TRUSTS AND TRUST METHODS

Much condemnation has been heaped upon trusts, their methods, and the men that control them. A great deal of this adverse criticism has been of an unintelligent nature, and is the result of an inadequate knowledge of what trusts really are.

AN ILLEGAL TRUST.

That corporation, body of men or society that monopolizes an industry or controls the great part of it, and puts restraint on legitimate competition is illegal, and has come to be known as a trust. Against these soul and body crushing organizations, political parties have fought, legislatures have enacted laws, and competing business men have turned their heaviest argument and ammunition. It should go without saying that a monopoly is not necessarily detrimental to the best interests of the general public.

BIG CORPORATIONS MAY BE JUST.

It must be admitted that large corporations which have cheapened methods of production, and even control every channel of trade in their particular line, can be just to the consumer. As a matter of fact, such corporations generally abuse their privileges, and for that reason the public mind has come to consider every capitalist, every big corporation, as a blot on the economy of the universe. After having warned the reader to beware of prejudice against capital simply because it is capital, and is powerful, let us examine the workings of the so-called trusts—the evil monopolies.

SPECIAL PRIVILEGES GRANTED BY ENACTMENT.

Economists have said that monopolies could not live were they not granted special privileges, such as the right to lay gas or water pipes in a city's streets, to string wires, lay railway tracks, build pipe lines from state to state, and construct tunnels for pneumatic tubes, etc.

POWER OF THE MONOPOLY.

The power of the monopoly lies in the rights it possesses to the exclusion of competition. If only one gas company has the right to pipe a city, unless precaution of law is taken, it might be possible for that company to charge its patrons any price that would not be prohibitive of consumption.

To-day we see much of the supply of every-day necessaries controlled by trusts. The tendency of the age is towards consolidation in order to reduce expense of production. When there is only one company in a country using material for an article of manufacture which it controls, it may refuse to pay more than a price which suits its convenience, yet it can also refuse to sell its commodity unless it gets its own price.

VENAL LEGISLATION.

In order to bring about a perfect monopoly of its trade, legislatures are frequently bribed to pass favorable laws. Tariffs that will favorably affect commodities controlled by the trust are secured in congress, as are bounties to foster infant industries.

When all the separate companies in a certain industry are brought together, the capital thus consolidated is immense and can wield almost unlimited power.

THE STANDARD OIL COMPANY.

Take, for instance, the Standard Oil Company, with its enormous wealth. Rapidly has this concern seized upon, practically, the output of every oil well in the world. Through its immense business interests, it has been able to secure freight rebates, to control railroads, steamships, mines and banks, and to regulate the price of oil at will. If a small oil concern starts in business independent of the trust, oil will be sold by the trust so cheap that, eventually, the rival of the trust must either succumb to the ruinous competition and fail, or else become absorbed in the trust.

THE BEEF TRUST.

Much comment has been made recently on the beef trust. Several big packing industries in Chicago, with their branches in other cities, control the meat trade of the world. This trust is almost the only buyer of the live stock of the United States. Railroads discriminate in its favor in freight rates, and so compact is the alliance that, if an independent butcher attempts competition, he is undersold until forced from business. Cases are known where, in order to kill competition, the members of the trust have sold meat at 1 cent a pound, until the individual competitor was ruined. In the same way this meat trust often refuses to take live stock at the prevailing market value, in order to glut the market and secure stock at very low figures.

A GOOD TRUST.

Occasionally a monopolizing company conducts its business in a legitimate manner, simply buying in the market at fair prices, and by economizing, allowing the public to share in its prosperity by selling goods at reasonable rates. Such good trusts do not fear publicity, and are a great blessing to business. More often, however, where a trust really controls its product, as in case of the hard and soft coal trusts, great harm may come to the public from its bad methods. The action of the hard coal trust in its stubborn refusal to arbitrate the strike of its miners in 1902 wrought much evil.

TRUSTS WIDELY POWERFUL.

Some trusts, not content with controlling the business of a certain line in one country, form international concerns, and influence the commerce of the whole world. At present there are railway combinations controlling lines from coast to coast. The steel trust, capitalized at nearly a billion dollars, commands the situation in the American steel and wire trade. There is a shipbuilding trust, an egg trust, cereal combinations, a sugar trust, a tin-can trust, a carpet combination, a cattle-growers' combination, a grain growers' trust, a harvesting machine trust, as well as numerous others, the capital of which amounts to many millions of dollars.

THE SPECULATOR'S TRAITS AND METHODS

Of all modern occupations, one of the most picturesque is that of the speculator who makes fortunes in the great stock and grain exchanges of the world, loses them on an unfortunate turn, and with great fortitude and energy wins them back again. To the public that learns of this man and his life work, he appears with a certain glamor, but in general, he is considered merely a gamester, who bets on the turn of a market.

HARD WORK ALONE BRINGS SUCCESS.

Men of such a grade, however, are hardly worthy the dignified name of speculators. True, the speculator has in him above everything the gambling instinct, but it is not by mere force of dollars and terrific gambling plunges, that the typical speculator wins immense fortunes. Here, as elsewhere, hard work only brings success. To the public it is only the spectacular side of the stock or grain market operator that appeals with force. But, back of the whirr of the grain pit or the stock post, must lie indefatigable study and application, a resourcefulness almost matchless, and a knowledge not only of the men with and against whom one is trading, but of every fiber of the fabric of the commercial and financial world.

CONDITIONS COVERING SPECULATION.

To the speculator the insignificant happenings of a day may mean much. The values of speculative commodities may be affected by the slightest turn in public sentiment over a political situation. A war cloud, even though it be as small as a man's hand, may mean ruin or prosperity to him. These conditions all must be mastered both by a knowledge of them and their exact effect on lasting conditions, and by a knowledge of what opposing forces may develop from them.

THE GREATEST SPECULATOR IN WALL STREET.

Probably the greatest manipulator of stocks in celebrated Wall street is a gentleman who has been twice a multi-millionaire, and once a bankrupt for millions. Some men of the stock market desire to be identified closely with the companies whose stocks they manipulate, or buy and sell, up to hundreds of thousands of shares. Not so with this unique character. He is a manipulator pure and simple, one who by force of his large following of smaller speculators, and by his great foresight, can influence a market up or down by his plunges. To the layman, he simply bets on the rise or fall of the market quotations. To the initiated, however, it is upon faith in his knowledge of conditions that will influence the prices of stocks and bonds, that he makes his winnings. So far from being a stock gambler who bets on quotations, he can be called the one who makes quotations. Many times has he faced apparent defeat, and once he was ruined, as a result of trying to handle 1,000,000 bushels of wheat against his own judgment. At that time he showed the metal of which he was made. Falling from high life, he, a man used to luxury and the good things of the world, contented himself with a simple country house until by the same sagacity that made him rich once, he again became the envy of all speculators.

SPECULATORS WHO HAVE FALLEN.

There is another side of the speculator's life. While the fortunate ones are in the public eye and are heroes, there are others who have fallen in battle. It must be known, that while supply and demand and real intrinsic worth have much to do with the price at which the public buys and sells stocks, grains, cotton, etc., on the other hand,. plunging, cornering a market and other kinds of manipulation, regardless of merit, may affect prices greatly. Thus we see times when one speculator, who is a "bull," has caught his arch-enemy "short," in such a manner that millions of dollars may be squeezed out of him. Men are prone to sell what they have not in their possession, trusting to conditions to depress prices and permit them to buy in at lower figures. But often this plan goes awry. The long line of "ghosts" of the stock brokers' offices, —men who have been buffeted in the fight, and who still haunt the scenes of their former victories, testifies to this.

SPECULATION SOMETIMES A DISEASE.

Speculation is in some people a disease in the blood that mounts to the head. Men may be cool and calculating in speculation; they may bravely withstand defeat and plan other great coups, but they cannot get away from the sound of the ticker, or the excitement of the market, after having won or lost a fortune.

TWO GREAT EUSINESS BODIES

Stocks and bonds, — money-exchanges, boards of trade—these terms convey little meaning to the many. The general opinion prevails that dealings in the stock and grain markets savor of nothing but gambling. To much of the trading in the great exchanges of the world this stigma must attach. On the other hand, these great exchanges fill a needed want in commercial and financial life, for which America has of late years become so justly famous. Let us look into the character of the men and operations of these great markets, which send out their influence to every portion of the world.

THE NEW YORK STOCK EXCHANGE.

Of greatest influence in the country, financially, from the point of view of the speculator, are the operations on the New York Stock Exchange. This famous bourse is located in the short but widely known New York thoroughfare—Wall street—and is an association, of limited membership, made up of men who gain a livelihood by buying and selling securities, such as stocks and bonds of the great railway and industrial corporations of the country. In the majority of cases, the sale of these securities is for third parties, who, recognizing that the stock exchange is the trading place where such investments can be made, commission these brokers to transact their business for them.

ORIGINALLY A CONVENIENT MARKET PLACE FOR SECURITIES.

From this statement it may readily be drawn that in the beginning the stock exchange served simply as a convenient market-place where the best bargains could be made in the matter of investment of idle earnings. Such was the case, and the prin-

[illegible]

[illegible]

[illegible]

By [illegible] Lawrence & Co.

GENERAL VIEW OF THE [illegible] LOAN & TRUST BANK [illegible] SHOWING THE DAILY [illegible] OF BUSINESS

[illegible] Modern Arrangements [illegible] Banking

be[illegible] now make the most money in direct speculation on the rise or fall in the price of securities listed on the exchange. This gradually has led to the charge of stock gambling which is often justly made against that great medium of financial transaction. It is this speculative side of speculative arena, men pay as much as $80,000, and more, for memberships.

A SPECIFIC CASE.

In order more clearly to explain the nature of transactions in stocks and bonds, a specific case may be cited. Let us say that "A" has idle money at hand which he de-

sires to invest with a view to a good profit on his investment. He commissions a member of the exchange to buy for him a certain number of shares of a favorite stock or bond issue, at a stipulated price. The broker is paid his commission for transacting the necessary business and "A" becomes the owner of the shares. In case there is an advance in the value of the shares by reason of a betterment in the earnings of the corporation, thus bringing about increased interest or dividends to the owner, "A" may desire to sell his possessions. In that case, the broker may be instructed to sell the stock and A makes a good profit on his investment. If, however, the earnings are sufficient for "A," he may hold his stock indefinitely, for the dividends that accrue to him. This latter proposition is the more legitimate side of the investment.

To the speculator on the rise and fall in stock prices is due the business of buying on margins. This has entailed an operation called "selling short," which is truly nothing but stock gambling.

"MARGINS."

Operations on "margins" are the same as those cited in A's transactions save that instead of buying or selling the stocks or bonds outright, the business is done on a margin—that is the customer puts up about 10 per cent of the value of the stock traded in, and the broker lends the money at a fair rate of interest with which to complete the business. Thus "A" is able to buy heavily on a small capital. The trouble that often befalls a marginal trader is that in an erratic rise or fall of prices, the value of a stock may drop below or rise above the margin put up by the customer, in which event if more margins are not put up by him, the broker will close out the trade, and the customer loses the amount of the margin deposited.

"SELLING SHORT."

Short sales constitute selling stocks or bonds that one does not possess, trusting that conditions in the market will result in a depression of prices which will enable the seller to buy in the stock or bonds at a figure lower than the price at which they were sold short, thus giving the seller an ultimate profit. This sale is a contract to deliver to B by A a certain number of shares at a given price. Margins are also put up on short sales so that in case prices advance instead of declining the broker who sells for A and consequently has lent money with which to complete the transaction may be indemnified in a rising market.

"BULLS" AND "BEARS"—SLUMPS.

It might be well to define a number of phrases commonly used in financial circles, namely:

A "bull" is a person who favors an advancing market or price of securities; the term is supposedly derived from the action of a bull in tossing things upward.

A "bear" is one who favors lower prices; the term said to have resulted from the action of a bear in pressing its prey to the ground.

A "slump" is a marked depression in prices.

"PUTS."

A "put" is an option on stocks or grains which allows the seller of the "put" to deliver to the buyer certain stocks or grain at a price stipulated some time before the transaction. The price named is generally much in favor of the seller and the option enables him to "put" the commodity to the purchaser at a price generally higher than

BOARD OF TRADE, CHICAGO, IN SESSION.

the market figures. This transaction is at the option of the seller.

"CALLS."

"Calls" are options just the opposite to "puts," enabling the buyer to demand the delivery of the commodity from the seller, generally at a lower price than the market figure. This transaction is at the option of the buyer.

THE "POOL."

A "pool" is an aggregation of speculators united to operate in certain stocks or commodities on exchanges. In railway circles a pool is a consolidation of interests by which certain earnings are made jointly by a number of roads and divided among the individual members of the pool at certain periods.

THE "CURB."

The "curb" is a market for commodities not listed on a regular exchange. This term derives its name largely from the fact that such trading was originally done on the street curb.

THE "ROOM TRADER."

The "room trader" is a member of the exchange who buys and sells for himself more than for outside customers.

A "CORNER."

A "corner" is a condition in the market when all the available supply of the article traded in, has been absorbed by a man or clique of men. This situation is generally brought on by very heavy short sales. The "shorts" can redeem their sales only from the crowd that has the "corner," who are invariably "bulls." The "bulls" then proceed to push the price up fabulously and the shorts must pay the difference between the price at which they sold and the price set at the will of the bulls. This condition often brings on a panic and sometimes results in the bankruptcy of the "shorts."

CANARDS.

It is no uncommon thing for the stock market to fluctuate violently on the merest rumor that tends toward financial depression. Because of this panicky feeling that often exists in the investing public, speculators often willfully set about to invent canards that will influence prices favorably to their operations.

OTHER STOCK EXCHANGES.

There are numerous other exchanges than that in Wall street, among which are those of Chicago and Philadelphia, the Mining Exchanges of Boston and Denver, and several other leading cities. In New Orleans, the Cotton Exchange is prominent for operations in the cotton market; the New York Cotton Exchange is also prominent in this trade.

THE CHICAGO BOARD OF TRADE.

Of as much influence, although of a different character, is that exerted by the Chicago Board of Trade, an exchange on which are regulated the prices of the grains and provisions of the world. This exchange is governed largely after the same manner as the New York Stock Exchange, excepting that the contracts made thereon are by members of the board for delivery of certain amounts of grains or provisions at certain specified times.

"FUTURES."

This business is called trading in "futures" or making contracts for future delivery.

At the outset it might be supposed that the future character of the transactions on

the Chicago Board of Trade and the several boards of trades in the principal cities patterned after it, were purely of a gambling type. Such, however, is not necessarily the case.

CHICAGO A DICTATOR.

Chicago, from its location in the Middle West, the center of the great grain-bearing country, and admirably equipped with lake and rail connections for transportation, is in a position to dictate the movement of grain to a great extent. At Chicago, are also located the great stock yards and slaughtering houses from which the world receives its supply of meat provisions. Inasmuch as Chicago was a pioneer in the matter of grain handling the transactions on its board of trade gradually grew to proportions where they exerted an influence over the whole world. In this city are located the great elevators whence pours forth much of the supply of the world's breadstuffs.

Trading on the board of trade is done to a great extent in cash commodities, in which event the business is simply a purchase or sale similar to that over any counter. Purchases or sales for future delivery, however, are the life of the board, and constitute contracts for the delivery of grain before the last day of a specified month.

THE MONTHS USED FOR "OPTIONS."

The months of the greatest trading are those in which as a rule the grain of a harvest is most freely delivered, i. e., September and December for spring wheat, and May and July for winter wheat. Other months are traded in, but these show the largest transactions. Corn is dealt in most heavily in December, May and July. The contracts for these future deliveries are called "options." Sales for future delivery in almost every case are "short" sales. Occasionally, traders have the cash article in hand to deliver, and make sales for future

NEW ORLEANS COTTON LEVEE.

delivery when prices are high. If prices fall off, the short accounts may be "covered" without regard to holdings in hand, or the holdings may be delivered on the contracts, which is the usual course of trading.

A TREMENDOUS VOLUME OF TRANSACTION.

Naturally there is tremendous business on the greatest of grain marts, purely from a speculative point. To the uninitiated, such business may appear to be of a gambling nature. There is, however, one important aspect in which it deserves much commendation. Through the methods of trading in futures,—trading that may be strictly legitimate,—the price of grains and provisions is regulated in such a manner that the grain grower and the provision dealer receive for their commodities a price far more equitable than could be obtained by scattered transactions through middlemen, ranging over the country. In the Chicago Board of Trade and other establishments that have sprung up after its model, center all news and information as to crops. Statistics in these exchanges show with great

IN A PACIFIC HARBOR.

Merchant ships in the carrying trade with the Orient discharging cargoes and refitting at Bremerton. The economy of sail power, particularly on trading voyages, still keeps in commission many vessels of motley types, from the modest fore-and-aft schooner to the "clipper built" ships, which were once the pride of America, and controlled the tea trade of the world.

accuracy the probable supply and demand of the world. From these figures fair prices are set on the world's food supply. In case of great changes in supply and demand, or the conditions that regulate them, the quotations on the board of trade are first to feel the effects. Thus farmers may avail themselves of the best prices, and millers may readily contract for the wheat that they will turn into the next year's flour supply, knowing accurately the prices for sale and purchase.

ODD MOTIONS AND SIGNALS.

In the grain trade as well as in the stock market, there are in constant use a great number of odd phrases and signals, which mean much in great transactions, yet which convey little meaning to the public at large. Millions of dollars worth of grain change hands on the motion of a finger. Deals are turned by the quick fling of an arm, and in general, so staunch to a bargain are the operators that many a transaction is carried through to the end without a written agree-

SCENES IN THE "PIT."

ment of any kind. The scene in the pits of the Chicago Board of Trade when this wild trading is in full swing, resembles a mob of men in a stampede, all with arms in air and with seemingly no way to take them down.

INTERNATIONAL LAW

Between countries, as within them, there exists government which, while of the highest type, is yet of an anomalous order. International law is the code under which this government of the family of nations operates. Ages ago the dominating principle that existed among barbaric tribes was one of selfishness, the principal purpose of each petty king being to despoil his neighbor. Thus warfare was rampant.

CONFEDERATIONS, REPUBLICS AND EMPIRES.

When government was evolved with the growth of civilization more altruistic ideas began to prevail both among individuals and nations. Certain rulers saw that it was to their advantage to ally themselves with neighboring governments; peace was better than war. This led gradually to confederations, and later, to great republics and empires. We see in the coalition between the Grecian states against Xerxes' hordes of Persians this idea of common protection. Later, Rome gathered to itself the countries of the world. Then came the influence of Christian teaching to ameliorate barbaric conditions.

These drifts in governmental life indicated the eventual trend toward more perfect fraternity and altruism. In these crude agreements and treaties we see the tendency toward the more complex system of international law as we know it to-day.

By law one understands a rule or mandate enunciated by a power able to enforce its orders. In the strict sense of the word there can be no international "law," for, the enforcement of such laws presupposes a sovereignty above all governments subject to this law, to enforce it. Of course this does not exist, and in as much as every country is jealous in the extreme, of its rights of

independence and sovereign power, submission to the law by offenders is the only method of enforcement save by war. Yet in this late day commerce, the interests of trade and the interchange of citizenship between different countries, have united the most enlightened nations into a family. In this imaginary family laws are self imposed, Governments, and through them their citizens, simply agree to preserve certain fundamental principles laid down and understood, as beneficial to all mankind.

All sorts of sources are tapped to make up this body of law. Common-custom agreements between nations such as treaties, protocols, etc., conventions between nations, called to frame rules for international government, resolutions by peace congresses, and the like, all give to this law certain authority. In custom we see embodied the ideas of equity. If armies and navies must go to war, let it be done in as humane a manner as possible. Custom also dictates a general Christian spirit. Where certain nations agree to do or not to do certain things by treaty, these agreements eventually have some force and influence in similar directions, with other nations. Where conventions of public spirited people or delegates from different nations meet, empowered to draft rules for general conduct, great weight is carried.

THE FLAG OF TRUCE—RED CROSS—TREATMENT OF PRISONERS.

Thus we see the flag of truce recognized generally between the armies of combating nations. Through this growth of a more kindly spirit we see better treatment of prisoners and the recognition of the Red Cross of the hospital corps. All nations likewise concur in numerous laws which are for the good of all. In this category falls the law that pirates are the foe of all mankind and shall be punished by death. No immunity is enjoyed by a pirate even if protected by a nation's flag.

Naturally agreements or treaties between nations are expected to be observed, else they would not have been made. These agreements upon proper authority, become an integral part of the law of the signatory nations. It is the duty of each nation which is a party to the treaty to obey it to the letter, to abrogate temporarily any of its laws which come in conflict with the compact, and to compel its citizens to uphold it. Thus two nations may make tariff agreements which bind them alone; or they may agree to deliver up certain malefactors, such as murderers and other criminals. In extreme cases of breach of treaty, war is the alternative to protect the injured country's rights.

Conventions occasionally are held by representative men of civilized nations, to discuss conditions of the nations of the world. Present at these conferences, if they are of importance, are men delegated by governments, many of them in power to draft laws favorable to their particular countries. Thus, certain rules have been laid down for all nations which are beneficial to each alike, as in time of war. These rules can be broken only on penalty of severe punishment of the one guilty of the violation. Some of the international laws that have been drafted and held obligatory on civilized nations include the recognition of the flag of truce and the hospital flag referred to. Others drafted have ruled that during war shipping of neutral countries shall not be molested; that privateering shall be abolished; that blockades, to be binding, must be in fact, and must be maintained by a force

large enough to prevent access to the enemy's ports, and that murderous methods of warfare shall not be permitted.

TRIBUNALS FOR ENFORCEMENT OF TREATIES.

Naturally, tribunals must exist to enforce the rules of international conventions and treaties. Since international law enters into the body of the law of a land, its higher courts generally interpret it. Thus, in the United States the Supreme Court is the adjudicator of disputes over the law and in England the High Court of Admiralty generally acts.

In order to be properly represented in the various countries of the world each government appoints diplomatic and consular forces to be present all the time in the principal capitals and cities of the other nations. An ambassador or minister is an official appointed directly by the chief executive of a country to the court or head of the government of another nation. Generally these appointments are confirmed by legislative bodies. These men look after the interests of their sovereign or country, in the foreign state, the diplomatic agent taking care of governmental conditions, arranging treaties, etc., and the consular service taking note of commercial conditions and reporting them to the home country for the benefit of merchants and traders. The peculiar position of these officials abroad has laid down another law between nations that renders them and their families, houses, and public records inviolable in time of strife between countries. From this courtesy allowed by one sovereign power to another, there has grown up a fictitious notion that the sovereignty of a country follows its flag, and that, temporarily, the ship of a country floating its flag in a foreign port, or a diplomatic or consular residence, is actually the land of the country whose flag is flown. Such of course is not the case, but by agreement, ships and officials are given time to leave a country unmolested and in safety, even after war has been declared.

AMBASSADORS AND CONSULS.

The duties of these officials are of great importance and of great variety. The ministers often assume the duties of the consuls, and the consuls or agents of one country sometimes assume the duties of consuls or representatives of another country, when the latter's officials have to abandon their places because of war. The consul looks after the prosperity of his country from abroad, sending reports that will show merchants the best way to meet competition in the country to which he is accredited.

ARBITRATION, MEDITATION AND INTERVENTION.

Arbitration, mediation and intervention are the methods by which disputes between countries are often brought to an end. Countries are very jealous of their sovereign powers and seldom permit of interference of third parties in their troubles. Yet, sometimes, third parties step in to suggest a cessation of warfare when the struggle is carried to a great and cruel extreme. Nations have to resort sometimes to war to clear the atmosphere of disturbances. It is the only way where combatants will not arbitrate. Often, however, even after war, the warring nations will suggest committees to meet and arbitrate the questions at issue for them. This is generally done by each country appointing one party and these choosing a third, the decisions of the joint body being accepted. Some great disputes have been settled in this manner.

Sometimes a nation watches an unequal struggle between two powers, too long protracted. Then it may offer its good services between the struggling contestants in the hope of settling the disturbance. This is called mediation and, generally, is not unkindly received, even though it is refused. The third form of intervention is where a powerful nation simply steps in, takes matters in its own hands and enforces peace. This is intervention, such as the United States used in the war between Spain and Cuba. This method is seldom resorted to.

INTERNATIONAL CONVENTION AT THE HAGUE.

One of the most notable conventions for international law framing was that called the Peace Conference held at The Hague, at the instance of the Czar of Russia, in 1899. Here the question of universal disarmament was discussed with the view to universal peace. The nations were by no means willing to disarm themselves. One agreement arrived at, however, was for a permanent peace or arbitration board for the settlement of all disputes between the signatory powers. Any of these nations which was a party to the agreement may now feel fully authorized to step in and ask for a cessation of hostilities, although such action on the part of the United States government in the late war between Great Britain and the South African Republics was not well received.

POLITICAL ECONOMY

Political economy is that branch of social science, or economy of the nation as a household, which treats of the production of wealth and its application to the well-being of society. The word "political" is not used in the ordinary sense, but simply as it applies to the body politic—the city or state. In other words, political economy is the systematic arrangement of the laws which, under the present system of competition, govern the relations of man, whether individual or social, to the objects of his desires.

FOUNDATION OF THE SCIENCE.

The science is based on four elemental principles: 1. The unlimited desire of man for the development of nature's resources. 2. The conveniences and comforts of civilized life, which are to be enjoyed only as the result of human labor. 3. The right of property in the fruits of labor, established by individual exertion with the idea of exclusive possession, as a natural consequence. 4. The natural possibility and right of exchange of the fruits of labor attending the right to property. All these things touch the sphere of man's social life with its manifold and complicated relations, from which proceed the most powerful incitements to stimulate desire, to nerve up labor, to maintain rights and to multiply and distribute the innumerable elements of wealth. The study of political economy delves into man's wants, nature's resources, the statistics of human invention and industry, and the principles which should obtain in social relations. Self-interest is regarded as the universal motive of human action, and in this study of prime interest, are the mutual relations and intercourse of men as governed by that motive. It takes it for granted that labor is irksome in most cases, and that

every man is striving to obtain the utmost possible gratification with the least possible effort.

WEALTH.

Since wealth, the fruit of labor and desire, is the principal thing about which this science treats, a clear idea of what wealth is should be obtained at the outset. The term wealth embraces all useful things which can be appropriated and exchanged. This naturally combines utility, or fitness to gratify desire, and fitness to be seized and held in exclusive possession. It is an error to identify wealth with money. Money measures things, and to a certain extent is a medium of exchange for all things, but it makes up only a small part of wealth. It is desirable not for what it is, but for what it can purchase. It is also an error to regard as wealth such things as mortgages, bonds, stocks and the like. These are simply indications of wealth which exists in another form. These are signs, not substance. It is also an error to exclude from the list of the things that make up wealth, a song, speech, or other things that are not tangible or durable.

VALUE AND PRICE.

In distinction from wealth, we have a term "value," which is only a vague way of expressing the desirability of an object. Value is purchasing power, or that quality which gives an object power to command other objects in exchange. Price is a term distinct from value, in that it has reference to a single article,—money. To illustrate the difference between the terms value and price, it may be said there can be no general rise or fall of all values, but there may be a general rise or fall of prices, from the inflation of currency, or some similar cause that affects money, which is the only object by which all things are compared. Value also is distinct from utility, for anything that gratifies a desire is of value, but some things of the highest utility, such as air, light, or water have no exchangeable value. Thus it may be said that value has two elements, viz.: utility and cost, or the difficulty of obtainment measured by the amount of labor necessary to secure the object.

PRODUCTION AND DISTRIBUTION.

From this point the study of political economy branches in several directions. Production and its methods and means, such as natural resources, labor, and capital, should be considered. The distribution of wealth such as property, wages, profits and rent, also come in for study. Then there follow the study of the exchange of wealth, of the laws which govern value, the rise and fall in prices, the stability of currency or money, the supply and demand which regulate prices, and other similar conditions. There is also the influence of society at large, and of government, upon wealth, its method of production, etc.

PROTECTION AND THE "BALANCE OF TRADE."

From the study of this science it has been thought at times that a nation could be regulated the same as a household, by adjusting the getting and spending of the national wealth. Thus have arisen doctrines, now in the main discarded by economists, such as that of "the balance of trade," which teaches that trade with any nation is profitable only when more can be sold to that nation than is bought from it. The system of bounties upon special trades arose, and similarly, has grown up to the great system

of protection to native industry, which has marked the revenue policy of the United States for many years past. Following the laws and theories on this question, have arisen numerous schools of economists, who believe that their particular tenets constitute the cure for all ills. Among these schools are the socialists, the communists, the single-tax followers, and even the anarchists, who believe in no government.

In the space permitted here, it is not possible to treat of the details of the numerous laws which make up this science. Those subjects most important for consideration are the actual methods that have been put into use by governments, or have been made the rallying cry of some political party.

FREE TRADE.

Free trade is a term expressing a principle which has been used to a great extent as a party platform for the Democratic party in the United States. Trade consists in buying and selling.

There is free trade when there is no interference with the natural course of buying and selling, if such interference be intended to improve or otherwise to influence trade. It is necessary to keep this distinction in view, because there are many laws not contrary to the spirit of free trade, which interfere with buying and selling. For instance, it is unlawful to deal in slaves, because we do not acknowledge the right of one human being to be the owner of another; it is unlawful to sell intoxicating spirits without having obtained a license, because the tax for the license brings revenue to the treasury, and intoxicating spirits are a commodity which it is advisable to tax in preference to the common necessaries of life, or even harmless luxuries. Many of the last named cannot be brought into this country without paying customs duty. In some countries, however, this tax is for revenue merely, and is a restraint on trade.

IMPORTS AND EXPORTS.

The many attempts made by governments to regulate trade for the purpose of benefiting the communities over which they rule, may be divided into two great classes: the one prohibiting the exportation of commodities, and the other encouraging exportation and prohibiting or discouraging importations. The former was the old rule in many countries. It was supposed that the wealth of the country depended on retaining within its limits certain productions of native growth or industry, and their removal out of the country was prohibited or restrained. Until a late period, the exportation of machinery was prohibited in some countries, but this was an exceptional remnant of the old rule which had yielded to its converse, in which it was maintained that exportation is the source of wealth, and importation is a wasting of the nation's wealth.

NATIONS LIKE INDIVIDUALS, IN TRADE.

Nations are like individuals, making in trade, profit on what they buy and sell. Whatever communities import they pay for by exports. This can be shown by analysis in any class of national transactions. If we pay for the goods we import by bills of exchange, these bills represent goods exported, otherwise they would not be paid. If we pay for goods in money, it is the same thing. It is a sort of a dynamic law that exportation causes importation just as a vacuum is filled up by air.

As applied to the individual, and not to the nation, free trade is the right of every

man to do as he pleases with his capital and abilities; and as the general desire of man is to improve his condition, and in fact, the great majority are thoroughly devoted to this purpose, the interests of the nation at large cannot be in better hands than in those of men, who, in increasing their own wealth, are increasing the wealth of the public. Free trade expresses the principle that a nation's wealth and prosperity are best promoted by securing the utmost freedom for the exchange of all commodities among its own people, and with the people of other countries. In contradistinction with free trade, protection expresses the principle that in order to promote home industry, the importation of certain articles from countries where they can be produced cheaper than at home, should be prohibited, or restricted by heavy duties.

OPPOSING THEORIES.

It is generally admitted by both parties that, theoretically, the presumption is in favor of free trade. For all economic processes and results in their general aspect, the law of free trade is most favorable. The right of property implies freedom for every one to do what he will with his own, providing he does not infringe upon the rights of others. Any law restricting the free exchange of one form of property for any other, or its free transfer from one place to another, is a violation of a natural, universal, inherent right. The social instincts of men prompt them to the practical adoption of this principle of freedom of exchange. Free commercial intercourse between the nations of the earth tends evidently to establish their mutual relations upon a basis of peace and good will. But by the mutual exchange of values, different peoples become acquainted and assimilated with each other, and a feeling of interdependence creates a common interest, out of which grow the ties of abiding friendship. The nations of men are of one blood and constitute one family; and all the face of the earth, with its great diversity of resources and productions, is given to the one human race. In view of these things, we are justified in saying that the presumption is strongly in favor of free trade. On the advocates of protection, is thrown the burden of proof of the soundness of the principle of restriction. Let us look at some of the arguments, pro and con.

It is said protection is necessary to secure that variety of industry and that balance of different industries which are essential to a people's prosperity. Every country has a great variety of resources, and the development of all its resources conduces to its greatest wealth. Among the population of every country there is a corresponding diversity of native talent, and labor is most effective when every one has scope for doing that for which he is best fitted. The actual wants of men are equally diverse, and the highest happiness of a community depends upon the degree in which all are provided for.

A DIVERSITY OF OCCUPATIONS.

A diversity of occupations makes a home market for all sorts of products, saving cost of transportation, favoring division of labor, and binding all classes together by ties of mutual helpfulness and common interests. Varied industry favors the social and moral advancement of a people, quickening and broadening minds, enlarging hearts, and impelling to noblest action in the lines of rectitude and benevolence.

The advocates of the protective system strongly affirm that it is necessary to secure diversified industry. Foreign competition

crushes out the home production of all but the crudest and coarsest articles of manufacture, and prevents the establishment of varied industry, unless the government interferes to restore the equilibrium by discouraging imports. Superior natural resources or more abundant capital, or cheaper labor, or greater skill and better improved machinery, may enable manufacturers in another country to produce certain articles more cheaply than they can be produced at home. If the way is open, the country having these advantages can, at first, control the marketing of these articles in a country less favored in this respect. Having once gained that control, it will do all in its power to keep it.

INTRODUCTION OF A NEW INDUSTRY.

The introduction of a new manufacture is a matter of costly experiment, and individuals should not be expected to bear the whole burden of carrying it on at their own loss, or great risk, until they are strong enough to compete with those who have had a long training and successful experience. It is contemplated that this burden will be but temporary, and will be more than compensated for by the greater ultimate benefits of a diversified industry fully established. Protection is needed to nurse our manufactures in their infancy, and to hasten their development.

Foreign competition bears directly and hardly on the wages of labor. The general rate of wages in our country is higher than elsewhere. Protection is also said to be a necessary means of maintaining national independence. It is of the highest importance that a nation in the time of war should be independent of foreign countries, with respect to supplies for subsistence, etc. The advantage of a home market for agricultural products presents a strong reason in favor of protection, because many products are perishable. It is also regarded, as before stated, as favoring the fullest and best application of the principle of the division of labor.

Protection is often advocated and used as a means of retaliation for commercial disabilities imposed by other nations. A foreign government bars out our products and, in turn, we refuse to receive theirs.

Aside from these causes for the protection policy, of which the Republican party in successive administrations of the United States government has been the best exponent, political policy may be pointed out as one favorable argument. The business community in this country has adjusted itself to the protective tariff, and anything that threatens to disturb the present system causes alarm in manufacturing and other business centers, whether warranted or not.

PROSPERITY.

Gradually, a good many people have come to believe that inasmuch as great prosperity has followed the protective policy, it will continue so to do. Moreover, the revenues of the country have been so large from customs duties that the country has greatly increased its national wealth, and on a similar scale the protection of certain industries has been so marked that, becoming monopolies, almost, of the entire trade in their particular branches, they have dominated the world, and largely increased the influence of the United States.

On the other hand, we have a goodly array of argument against protection. Foremost, because what is known as the "Iowa idea," formulated by a section of the party that has fostered protection, is that heavy tariffs, such as have been enforced for this

man to do as he pleases with his capital and abilities; and as the general desire of man is to improve his condition, and in fact, the great majority are thoroughly devoted to this purpose, the interests of the nation at large cannot be in better hands than in those of men, who, in increasing their own wealth, are increasing the wealth of the public. Free trade expresses the principle that a nation's wealth and prosperity are best promoted by securing the utmost freedom for the exchange of all commodities among its own people, and with the people of other countries. In contradistinction with free trade, protection expresses the principle that in order to promote home industry, the importation of certain articles from countries where they can be produced cheaper than at home, should be prohibited, or restricted by heavy duties.

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Foreign competition bears directly and hardly on the wages of labor. The general rate of wages in our country is higher than elsewhere. Protection is also said to be a necessary means of maintaining national independence. It is of the highest importance that a nation in the time of war should be independent of foreign countries, with respect to supplies for subsistence, etc. The advantage of a home market for agricultural products presents a strong reason in favor of protection, because many products are perishable. It is also regarded, as before stated, as favoring the fullest and best application of the principle of the division of labor.

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PROSPERITY.

Gradually, a good many people have come to believe that inasmuch as great prosperity has followed the protective policy, it will continue so to do. Moreover, the revenues of the country have been so large from customs duties that the country has greatly increased its national wealth, and on a similar scale the protection of certain industries has been so marked that, becoming monopolies, almost, of the entire trade in their particular branches, they have dominated the world, and largely increased the influence of the United States.

On the other hand, we have a goodly array of argument against protection. Foremost, because what is known as the "Iowa idea," formulated by a section of the party that has fostered protection, is that heavy tariffs, such as have been enforced for this

purpose, in reality foster trusts and monopolies, by driving out foreign competition. This strikes at the root of protection. Akin to this idea is that of reciprocity, or trading with a friendly country on a free basis, but by treaty. Anti-protectionists argue that if it is good to exchange with certain friendly countries on a treaty basis, the same idea carried still further would be productive of further good.

Protection introduces and fosters antagonism between the different industries of the country: The idea of giving protection to every branch of industry is absurd. The theory implies special encouragement to the production of certain articles. But when government interferes to favor one industry by raising the price of all its products, it taxes all other interests. The unnatural stimulus given by protective legislation to a single industry leads to over production and consequent stagnation and failure. Protection diminishes the legitimate revenues of the government, at the same time that it

DUTIES FOR REVENUE ONLY.

lays a heavy tax on the people. A government must be sustained by revenues derived from taxation. The imposition of equitable duties on imports is admitted by the advocates of free trade as a legitimate mode of raising a revenue. A strictly revenue tariff has no discouraging influence on trade, nor does it conflict with the free development of a nation's varied industries. But a protective tariff has another end in view. That end would be most fully obtained by duties high enough to prevent altogether the importation of certain articles.

The policy of protection in its application must be unstable, disturbing the course of industry by frequent changes. Protection tends to demoralize national legislation. The so-called lobby influence at Washington has become proverbial. Protection tends also to corrupt the public morals and the public service. It offers a strong temptation to the violation of the law, by smuggling.

THE PROPER CIRCULATING MEDIUM.

In the study of political economy, much attention has been given to the subject of money and currency. The country has seen great waves of change in ideas as to the proper circulating medium. Careful study will convince any one that, as we have said, the value of money lies not so much in its intrinsic merit or value, as in its utility as a measurer for exchange, and to some extent as a medium by which exchange is made. Gold has been in constant use by most countries of importance, because, seemingly, its fluctuation in actual value as compared to the value of the things exchangeable for it, is less than that of any other precious metal. For an ideal measure of exchange several qualities are necessary. It should always bear the same relative value to other things—those things whose value is to be measured by it: it should be in sufficiently large supply to serve as a medium, and of convenient size and weight. These determine its serviceability, both as a measure and as a medium of exchange.

In the original state of trade, everyone simply bartered one thing against another. To-day, when most business is done on credit, we must have a third thing by which to measure one thing against the other. This, if it is acceptable to everyone, and has the qualities noted, will be good money. Naturally, supply and demand cause fluctuation in money as in other commodities. If the currency of a country is suddenly

inflated by heavy issues, it cannot be quickly absorbed, and falls off in its purchasing power. This was the harm done by the excessive issues of greenback money, and it was this inflation, instability of value and medium power, that people objected to in the free coinage of silver. It was known that the price of silver fluctuated violently at times, and consequently it would not serve as a stable measure of exchange, for future contracts. The most ideal measure would be a composite of all values of all commodities, compared with each other, to serve as a unit. That is by comparing cloth, potatoes, gold, silver, coal, eggs, butter, etc., a unit could be arrived at which would never relatively change. This, however, is considered impracticable.

INTRINSIC VALUE—CREDIT.

Intrinsic value is a good thing in money, for then it is not necessary to vouch that the measure of exchange when presented in exchange is of good value. As a matter of fact, governments, and private firms, to a great extent, simply use the dollar in the United States as a convenient way of measuring the exchange of goods, and often do millions of dollars worth of business with the actual exchange of only a few dollars. This is credit. The government does likewise in monetary matters. Great issues of money are put out for the use of those who need a medium of exchange, but much of this is simply printed paper—in other words we do business on the credit of the government, which assures the final payment for the paper in actual value. Faith in the government sustains this credit.

PANICS.

One of the most dramatic events in the history of any nation is a panic. This is purely a phase of political economics. It has to do with the expansion of credits to such an extent that business is no longer safe, and fear, coming over the people who have granted credit, brings down ruin on financial and commercial undertakings. A panic is the direct result of over speculation. When times are good and everyone has plenty of wealth, and more than he needs, he seeks to find some way of investing it. He lends his wealth, gives credit, and enters enterprises of dubious character without hesitation. With so much money on hand, prices advance, people feel in good spirits and everything is boomed. Then the trend in this direction reaches its limit. Men who have borrowed against the future find that they have invested poorly, and have no means with which to reimburse their creditors. Creditors become frightened at the risk; everyone calls for a return of loans, and no one cares to give credit except at a greatly advanced interest. Inasmuch as the greater part of the business of the country is done on credit, this sudden contraction brings on a desire on the part of everybody to secure value or cash money for what they have in hand that is of value. No one, therefore, wants to buy; all desire to sell. Prices fall terribly. People who owe debts, when they have realized only a small sum for what they thought was very valuable, see that they cannot meet their obligations, because their wealth has diminished in price measure. Bankruptcies follow, and sometimes the disaster spreads ruin over many.

DARWIN'S THEORY OF EVOLUTION

We hear much idle chatter in these days about man's descent from the monkey, without always knowing just what idea the speaker really intends to convey. It has become such a common expression that it is used as a joke, when in reality the theory of evolution underlying it is one of the greatest discoveries of the last century.

"NATURAL SELECTION."

Darwin gave to the scientific world a new idea when he issued his book entitled "Origin of Species by Means of Natural Selection." Darwin, however, rarely used the word evolution. This more truly lies within the world of philosophy than within the world of science. Science must deal with facts, and philosophy may wander with hypotheses into illimitable space. Thus Darwin propounded the idea that he had collected evidence sufficient to make him believe that certain species of animals, flowers, etc., might have originated from a common ancestry in the same way that varieties have done, and, that inasmuch as we recognize the family resemblance of several varieties of dogs,—the pug, the bull, the spaniel, the collie, etc., why not believe it possible that the wolf and the fox may be distantly related to the dog family? Or, as no two human beings are alike, why might not the horse and the zebra simply be different varieties? Why might they not originally have had a common ancestry, and through the same vicissitudes that change individuals, have been separated into species of their own?

SURVIVAL OF THE FITTEST.

The doctrine of the survival of the fittest plays a great part in "natural selection." While we know that the farmer carefully selects the best grades of wheat from which to raise his crops, the best apples from which to plant new orchards, and the best flowers from which to slip new varieties—we are not always so ready to accept the theory that nature may do for nature the same as man artificially does for nature. Herein lay much of Darwin's valuable information. Through much investigation he saw that certain tendencies were toward the killing off of the weaklings. All the time, powerful agencies are at work selecting the best species to propagate further. Conditions of life prove that many creatures must fall in the struggle. Only the best protected birds and animals can survive the hardships of an extraordinary winter. Animals poorly equipped with feathers and fur must perish. Thus the best will be left to propagate and give their progeny the benefits of our inheritance from the strongest of parents. Or, the struggle may be between enemies. One animal may be able to run faster, and another to fight more fiercely—this is what Darwin called natural selection. We know that climate makes a great difference in plant and animal life. From these two ideas it is a short step to believe that a species we may call the cat, is simply the domesticated result of years and centuries of selection in one direction, while the tiger is the product of a diversified selection.

NO TWO BEINGS ALIKE.

That species are constantly subjected to slight variations, and that those variations may be cumulated by selective breeding, is a known fact. Every organic being has an

individuality of its own. No two persons are alike. Even the creases in a person's finger tips are such as to identify that person from another. Still, these variations are restricted to pretty well defined limits. The percentage of variation in the individual form is small, and in the main the progeny is like the parent. While the changes are small enough not to be greatly important in character, still they serve as a basis for the production of permanent varieties. Let us watch the breeder of horses in his selection of horses of great speed rather than strength, for race horses, and those of great power, for draft horses. And the same conditions prevail in selection in plant life.

TOES AND TEETH.

In our own lives, if we are careful, we can see wherein we do not use certain faculties, and thereby we lose them. For instance, by wearing tight shoes for centuries, the toes, especially the little toes, have gradually become deformed. Where once man had great prehensile power in his toes, he has little now. And this is all the more clear in the case of savage tribes in the wilds of the eastern hemisphere, which can use their toes for many purposes with great dexterity. Some have been discovered that can row boats with their feet. The inference is that, in many generations to come, not having need for little toes, they will gradually disappear. The same condition obtains with the teeth. These change their shape as their owners, through generations, change their method of eating. Gradually, the wisdom teeth seem to be disappearing.

Sane philosophy builds up as well as deduces from every observation. And here it may be well to speak of atavism,—or that tendency of forms once common in a species to show themselves after having disappeared through natural selection. Much study has led scientists to conclude that things will not simply originate of themselves. Even evolution works out from some primal force that is constantly at work, changing naturally or artificially. Therefore, when odd formations are noted in life, some reason is deducible. These reasons, with evolution as the explanation, seem to be arrived at simply. Thus the appearance of strange formations is used to trace the origin of certain species, through many different forms, back to one parent.

ATAVIC FORMS.

It seems a sharp jump thus to conclude that human beings are evolved from apes simply because the latter walk upright at times, have four limbs, are mammals, etc. As a matter of fact it is not necessary to believe this. Yet by comparison of two distinct kinds of apes we find there is greater difference between them than there is between their highest type and the lowest type of human. Frequently we find the presence of some atavic form in mankind which, seemingly, has no business in the species. Many men have slight, scum-like, eyelids, or rather the beginnings of them. These are not common with man, but in many forms of animal life; especially in birds, this underlid is common. Now and then we hear of human beings equipped with stumps at the end of their spines, like the beginnings of short tails.

EVOLUTION NOT ATHEISTIC.

One of the greatest difficulties of the religious man is to accept the doctrine of evolution because it seems to leave out God and the creation. Evolution is not necessarily atheistic. When looked at merely in its results as discovered in scientific facts,

there is no ambiguity in the thing which Darwin is thought to have proved—namely, that somehow, through the action of heredity, variation and natural selection, species have originated in much the same manner that individuals of various traits have sprung up in the same species. The difficulty comes when we launch out and try to inject into beliefs of the origin of things, ideas and doubts about the dependence or independence of creative origin and control from God. Some great authorities have tried to theorize on the subject, and find no working plan complete without God. Machines do not make themselves or spring up out of the ground. And when we see a marvelous machine at work turning out steel needles from a block of steel, should we discredit the maker of the machine? Man is constantly at work changing the face of nature. He pulls up weeds from his garden, he changes the color of a flower; the mother, by loving care, saves her child's life from sickness. It may readily be conceived that Divine interference in nature may be one of wisdom rather than of power. If man may inject his plans into nature, there is no reason for saying that God may not do likewise.

COMMUNISM AND SOCIALISM

In most civilized countries, the laws of the distribution of wealth are based on the recognition of private property. In view of inequalities which seem to spring out of the competitive system, a body of theories has grown up which has for its basis the abolition of private property, and a change such as shall establish society on another and possibly more equitable footing. To these theories the terms communism and socialism have been applied.

TWO CLASSES OF SOCIALISTS.

Letting the term socialism describe both, there may be said to be two classes. The supporters of the first are those who plan for a new order of things which would bring society to a voluntary association, or community, having all things in common holding. The other body of theorists would have the working classes, or somebody in their behalf, take possession of all property, to be administered for the general benefit of the country. They want to have the whole productive resources of the nation under the management of a general government, resting on universal, equal, and direct suffrage, by ballot.

CAUSES RESULTING IN SOCIALISM.

Without going into the merits of these theories, it may be said that they have sprung up largely because of the weakness exhibited by certain members of all communities. In the system of competition, all cannot survive the struggle; it is the strongest and fittest man that wins success. Combination of capital has become so huge that labor has had to combine to almost as threatening proportions, to protect itself. Monopolies control nearly all the sources of wealth. The world's meat supply is in the hands of a clique of men in Chicago. The railways and steamships of the world are fast closing together into gigantic trusts. Coal is held fast in the grip of a few men. Grain is

constantly being cornered by the great elevator speculators. Real estate is held tight. In this environment the man who is not equipped to fight with weapons of exceptionally strong brain and body, must either become servile, or be obliterated. At this point, socialism steps in to say that if the government controlled all resources as it does the postal department, there would be no excessively rich people nor yet any paupers. They hold that enough is a sufficiency for any person. Too much is bad, and with proper control of the sources of wealth, there would be no strikes, no famines in the midst of plenty, and no deaths from hunger.

SINGLE TAX.

Closely akin to socialism is the theory propounded by the late Henry George, and now the groundwork for the political action of a small but growing party. This theory, known as the single tax, is that all wealth comes from the ground. In the beginning the ground was as free as the air. Man used what he wanted of it, and left the rest for his neighbor. With the advancement of the property-rights theory, however, and its actual operation, land has become the main source of monopoly. It is held that man always should have free access to the benefits of nature. Water and air are free, but land is now owned so that a man must pay for the right to exist upon it. Moreover, land is held by the single tax advocates to be of no value except as it comes in contact with man. Society gives it value. Labor is necessary to produce wealth from it.

LAND THE ONLY SOURCE OF WEALTH.

Inasmuch, therefore, as land is the one source of wealth, it should also be the one object of tax. In short, the single taxers say all land should be accessible to any one. If two people wanted the same piece of land, naturally, the one willing to forfeit something for its use, should be the one to have that use. All taxes, direct or indirect, should be abolished, and in their place, should be established a tax on land values. If land lay idle, it would be of no value. Then a poor man could step in and use it. Naturally, his use of it would make it of some value, and he would be taxed somewhat. If the land was improved much and brought good results of labor, it would become so valuable that several persons might want it. Then the tax would increase. If someone wanted the land especially, he might pay the occupant a bonus to vacate, with something for his work in improving it.

A system of this kind, it is argued, would dispense with all taxing bodies, assessors, etc., save one; would render trade as free between the nations as between the several states of the United States; would place the burden of taxation on property which is most valuable; would make monopolies pay taxes according to the benefits they acquire from nature, would make it unprofitable to hold land unused, for speculative purposes, and allow unused land to be utilized.

Although the plausible theorizing of Henry George is held by a great majority of reputable thinkers to be visionary and chimerical, many of the ideas which he advocated are worthy of consideration, as they lead along profitable lines of reflection and investigation.

TAMMANY HALL

Political machinery has reached its perfection in the matter of control of elections in the great society called Tammany Hall—the Democratic organization of New York City. Notorious as the most deftly managed as well as the most corruptly governed of the political rings in America, this society is nevertheless such a factor in the municipal affairs of New York City, and even in state affairs, that it is a foe worthy of the best steel Republicans and reformers can command. Tammany may again be forced from its position of strength by the election of a reform mayor of Greater New York, yet such is the impress made upon the civic life of that great city that a description of Tammany's methods are worth the while.

AN ASSOCIATION FOR ILLICIT GAIN.

Be it known that Tammany Hall, while purporting to be organized as a representative body of New York Democrats, for civic good, is in reality, an association for "graft,"—in other words, a society with the political purpose of keeping the Democratic party in power in the city offices of New York, and the object of obtaining money by illegal means from citizens of all classes. Money is the constant demand of the Tammany men, and great have been the fortunes made from the ill-gotten pelf of "heeler" and "boss." Tammany's defeat in 1901 was not considered a permanent downfall, but was due to the overzealousness of its members to rob.

As a political organization, this society probably has no equal. Through a system of representation that reaches down into the very gutters of the city's population, votes are controlled in an absolute manner. The leader of the organization is aided by 35 district leaders, who in turn control men throughout their districts, and these men control others, until great power is attained. Patronage is the watchword, although in times past, "graft,"—"blood-money,"—has more appropriately described the object of the system. In the low dives of iniquity of New York's streets, in the houses of disrepute, gambling-hells, criminal resorts, and tough saloons, are hundreds of law-breakers. Shame though it be, Tammany Hall has not only protected these law-breakers in their crimes but has abetted them,—for money. In a word, the authorities in times past have sought office for the purpose of allowing wantonness, crime, and debauchery to go unmolested, and of reaping unholy profit from it. The ward "heelers" or underlings in Tammany are generally saloonkeepers, or the like, who can keep in close touch with the criminal classes. The dissolute woman, the thief, and the thug wish protection. The society wants money. From low to high the "coin" is handed up. Political bosses become millionaires, patrolmen in the police force pay large sums to secure their positions, and afterwards pronounce it a good investment.

COLLECTIONS.

The "collections" do not cease with the wretches of the slums. The most money, in past regimes, that has flowed into the coffers of Tammany Hall has probably come from "respectable" citizens, moneyed men who desire contracts for supplies and pav ing, and concessions from the city, or wish to be immune from persecution. It is a well-known fact that millions of dollars have

been subscribed to Tammany by such men, in excess of all political needs. Who doubts where the money goes, when the leaders of the society suddenly grow rich?

THE TAX FUND.

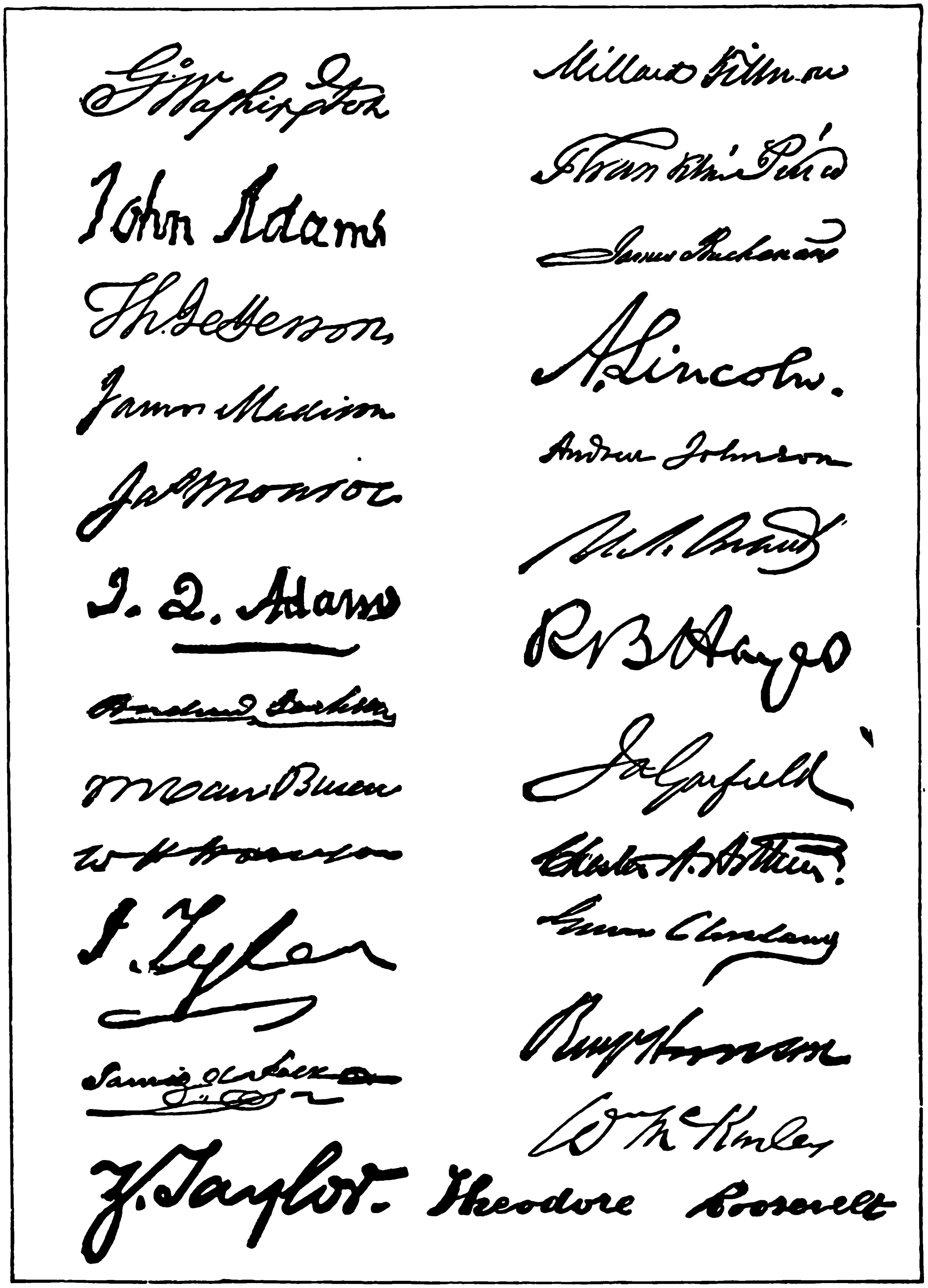
Another source of "graft" is the tax fund. The expenses for running New York's public offices in years past have frequently been as much as those for running the 15 next largest cities of the United States, combined. Delays of improvements have been made, double prices have been paid for supplies, and hundreds of men have been kept at work in public offices where they have not been necessary. This last form of "graft," possibly has been the most common, although possibly, not as much money has been lost thereby. Taxes have been evaded by wealthy corporations, and have been "fixed for a consideration," by officials paid and sworn to collect them for the city.

Not only are methods employed to protect officials but crime has been fostered by these powers. Frequently, during the last reign of Tammany, fallen women reported that they had been persecuted by blackmailers into resuming their vile lives, after they had tried to reform. Every attempt at reform was met by exposure to employers. The police were hand in glove with thugs, and more than one case was reported where, through contact with such debauching methods, policemen and detectives turned criminals, having become so crafty that they could easily deceive their own brother officers of the law.

It pays Tammany men to be in power—that is, financially. Thus the ward "heeler" can levy from the criminal for immunity from arrest. The higher politician can get money from big corporations that infringe upon the city's ordinances, and the bosses themselves can steal public moneys. Such has been the history of Tammany's past reigns. Is it to be wondered at that a successful attempt was made, in November, 1903, to bring these great forces together, in order to swing the power of office, and with it "graft," once more into the hands of Tammany?

HOW GREAT BRITAIN LOOKS UPON TAMMANY.

"Mr. W. S. Devery, ex-chief of police, hired a special train to take him and his followers to the State Democratic Convention at Saratoga after spending, it is said, $60,000 on a campaign to be made a delegate to that convention. 'It affords,' writes our American correspondent, 'an illustration of what some men are willing to invest for political place in New York City, expecting a good, if indirect, return for their money.' The car bears the words, 'Wm. S. Devery, Tammany Delegate.' A curious and characteristic point about the crowd is that there is not a single silk hat among the throng; all wear hard or soft felt hats."—London Times.



AUTOGRAPHS OF THE PRESIDENTS OF THE UNITED STATES.

BOOK VI

FACTS FOR THE CURIOUS

PAGES PITHY WITH USEFUL INFORMATION.

BATTLES OF THE CIVIL WAR

BULL RUN (first), July 21, 1861—North, General McDowell; killed, 481; South, General Beauregard; killed, 269. Shiloh, April 7, 1862—North, General U. S. Grant; killed, 1,735; South, General Albert Sidney Johnston; killed, 1,728. Seven Pines and Fair Oaks, May 31, and June 1, 1862—North, General George B. McClellan; killed, 890; South, General Joseph E. Johnston; killed, 2,800. Seven Days' Battle, June 25 to July 1, 1862—North, General McClellan; South, General Robert E. Lee; killed unknown. Second Bull Run, August 29-30, 1862 — North, General Pope; South, General Lee; no exact estimate. Antietam, September 16 and 17, 1862—North, General McClellan; killed, 2,010; South, General Lee; killed, 3,500. Corinth, October 3-4, 1862—North, General Rosecrans; killed, 315; South, General Van Dorn; killed, 1,423. Perryville, October 8, 1862—North, General Buel; killed, 820; South, General Bragg; killed, 1,300; Fredericksburg, December 11-15, 1862—North, General Burnside; killed, 1,128; South, General Lee; killed, 1,200. Murfreesboro, December 31, 1862; January 1, 1863—North, General Rosecrans; killed, 1,474; South, General Johnston; killed, unknown. Chancellorsville, May 2 and 3, 1863—North, General Hooker; killed, 1,512; South, General Lee; killed, 1,581. Gettysburg, July 1, 2 and 3, 1863—North, General Meade; killed, 2,834; South, General Lee; killd, 3,500. Vicksburg, July 3 and 4, 1863—North, General Grant; killed, 545; South, General Pemberton; killed, unknown. Chickamauga, September, 19 to 23, 1863—North, General Thomas; killed, 1,644; South, General Bragg; killed, 2,389. Lookout Mountain and Missionary Ridge, November 23 to 25, 1863—North, General Grant; total loss, 4,000; South, General Bragg, total loss, 4,000. The Wilderness, May 5 to 7, 1864—North, General Grant; killed, unknown; South, General Lee; killed, unknown. Spottsylvania, May 8 to 18, 1864—North, General Grant; killed, 2,261; South, Gen-

eral Lee; killed, unknown. Cold Harbor, June 1, 1864—North, General Grant; total loss, 10,000; South, General Lee; total loss, 8,000; Franklin, November 30, 1864—North, General Schofield; killed, 189; South, General Hood; killed, 1,750. Nashville, December 1 to 14, 1864—North, General Thomas; total loss, 6,500; South, General Hood; total loss, 23,000. Five Forks, April 1, 1865—North, General Grant; total loss, 7,000; South, General Lee; total loss, 15,000.

SLEEPING FLOWERS

Flower growers have discovered how to produce lilacs in autumn. It is quite a notable achievement, considering how peculiarly they are associated with the springtime, and the way in which it is accomplished is most curious and interesting. In a state of nature the lilac plant requires a period of rest before producing its flowers. That period is the winter, when the cold enforces repose.

EXPOSED TO FUMES OF ETHER.

But it is found that the plant can be cheated into blossoming in autumn by exposing it to the fumes of ether, which put it to sleep for a little while, after which it proceeds to blossom luxuriantly. Florists grow the plants in pots, and in the fall place them, pots and all, in a large box which contains an uncorked bottle of ether. In this manner they are exposed to the ether vapor for 48 hours, the box being airtight. Sometimes the operation is repeated a few days later. When they come out they are ready to start right in at blossoming, and the conservatory gardener obtains a fine crop of lilacs for the early winter trade. The process sometimes weakens the colors of the flowers, but this does not matter in the case of lilacs, because the kind preferred by florists is the white.

THE CLEANEST CITY IN THE WORLD

Washington, D. C., said to be the cleanest city in the world, is kept in that condition by the splendid system in vogue in the street cleaning department.

COST OF CLEANING WITH 130 MACHINES.

At the beginning of 1901, 130 sweeping machines were hired at $6.25 per month, with the understanding that they must be kept in repair, and become the property of the city at the expiration of the year.

Previous to the use of these machines, 210 men with hand brooms cleaned a dirty area of 1,565,800 square yards, or 413,765,028 square yards per year, at a cost of $76,429.47. The same force using the machines cleaned a total area of 515,992,920 square yards during the year at a cost of $79,704.46. Thus for the extra expense of $3,264.99 with the machines, an area of 102,227,892 square yards was cleaned in addition to the area previously gone over with hand brooms.

CLEANING THE ALLEYS.

The work of cleaning the alleys during the year was performed under a contract at 32¾ cents per thousand square yards. These

alleys are cleaned once a week, the schedule for each day being made at the beginning of the year. The total yearly area of 39,-290,597 square yards was cleaned at a cost of $12,259.29. During the year, about 14 miles of unpaved streets were sprinkled daily, for 131 days, at a cost of $3,150.27.

TOTAL AMOUNT OF GARBAGE.

The total amount of garbage collected during the year amounted to 30,299 tons, on 10,299 tons of which a reduction was made at the rate of 50 cents per ton. This gave to the District of Columbia, with the fines, a total of $5,686.50, to be deducted from the contract rate, leaving a balance of $46,069 to be paid to the contractor. A big saving was made in this department, as the collection for the previous year cost $10,939 more. This year, in place of the former weekly collection, semi-weekly collections are being made, and in some sections three collections are to be made a week.

POPULATION OF THE UNITED STATES

This country began the present century with 80,143,276 inhabitants. At the beginning of the nineteenth century there were 5,308,483 people. In the year 1810, the population was 7,239,881, an increase of 36.28 per cent; in 1820, the population was 9,633,822, an increase of 33.66 per cent; in 1830, it was 12,866,020, an increase of 32.51 per cent; in 1840, it was 17,069,453; an increase of 32.52 per cent; in 1850, it was 23,191,876, an increase of 35.83 per cent; in 1860, it was 31,443,321, an increase of 35.11 per cent; in 1870, it was 38,558,371, an increase of 22.65 per cent; in 1880, it was 50,154,783, an increase of 30.08 per cent; in 1890, it was 62,622,250, an increase of about 28 per cent; in 1900, it was 76,295,220, an increase of 26 per cent, with a fair chance that these figures will be greatly changed before the year 1910. These figures are exclusive of the Islands of Porto Rico, the Hawaiian Islands and the Philippine Islands, which bring about 10,000,000 more people under our dominion.

AS COMPARED WITH RUSSIA.

Russia has the most people, but at our rate of increase it will not be many years before this country passes Russia.

Another interesting fact is that the English language is spreading twice as rapidly as any other tongue, so that the future promises to the United States the leadership not only in population, but in the number of English speaking people.

"CUP DEFENDERS" WORTHLESS FOR CRUISING

Very few people realize how utterly worthless for all purposes excepting racing is the ordinary cup defender. As a matter of fact craft of this kind are not entitled to be called "yachts" at all. They are racing machines pure and simple. This year, more than ever before, they have reached the limit.

RACING MACHINES COSTLY.

The last boat built to defend the cup was enormously expensive to construct, equally costly to keep in commission, and worthless for cruising purposes or for any of the uses to which the ordinary yacht is put. It has no cabin room and requires an enormous crew. Here there is not room for a man to stand up below the deck.

LACK OF SPACE BELOW DECK.

The distance between the floor of the yacht and the deck is hardly more than a man's height. This, however, would not be so bad if it were not for the braces and cross beams, which cut up the interior of the yacht from stem to stern. Steel braces cut up the cabin room at angles of forty-five degrees every few feet. It is impossible for two men to walk abreast inside the yacht anywhere between the bow and stern.

Under these circumstances the construction of a cabin, or of comfortable quarters for the crew, is impossible. All that the inside of the modern racing machine is good for is, therefore, to store spare sails, blocks, spars, tarpaulins, etc. With a boat of this kind, requiring a large crew, it is impossible to go on a cruise, no matter how much her sail area may be reduced, for there would be no comfortable quarters below deck.

THE OLD-FASHIONED YACHT.

The old fashioned yacht, on the other hand, was most comfortable for the owner and his guests and the crew, and indeed the pleasantest part of the craft was below deck, where a cosy cabin with ample room afforded every facility for enjoyment of life.

OWNERSHIP OF LAND IN AMERICA

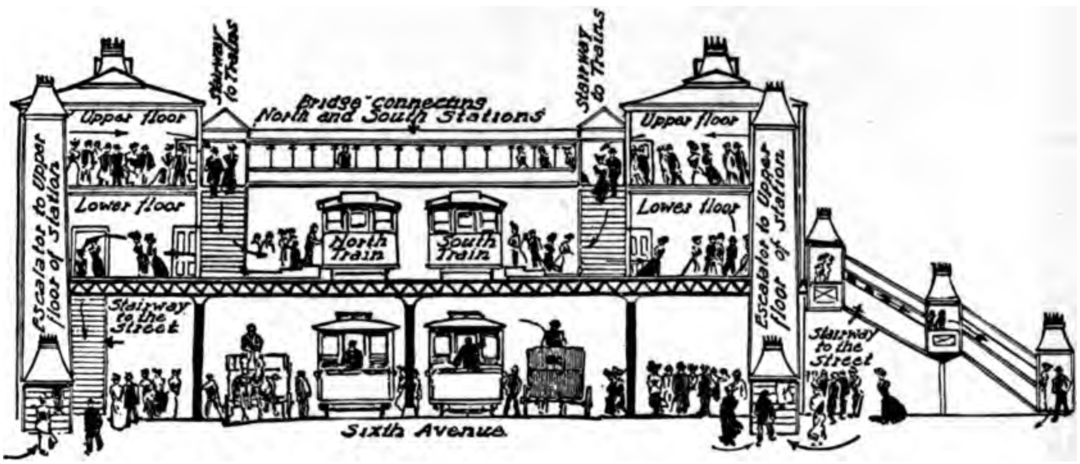
Twenty-two million acres of land in the United States belong to men who owe allegiance to other governments. Massachusetts contains 2,720,283 acres of land; thus it is that men owing allegiance to other powers own more than enough land to make eight states of the size of Massachusetts. The largest amount of land in this country owned by any one man or corporation, is the property of a company called the Holland Land Company. Twice as much land is owned by aliens in the United States as is owned by Englishmen in Ireland.

LARGE LANDED PROPRIETORS.

William Scully, of London, is a fair specimen of this class of plutocrats. He owns forty thousand acres of good farming land in Logan County, Illinois, besides large tracts of land in other counties. He rents this land for cash at a high rate, requires his tenants, who are mostly poor people, to put up their own houses, barns and farm buildings, makes them pay all the taxes, and receives from them $150,000 annually for permission to till the soil they live on, the value of which they have mainly made. He is only one of a large class of foreigners who own vast tracts of land in the United States. The Earl of Cleveland owns 106,650 acres; the Duke of Devonshire, 148,626 acres; the Duke of Northumberland, 191,460 acres; Baron Tweeddale, 1,750,000 acres; Byron H. Evans, 700,000 acres; Robt. Tenant, 530,000 acres; the Duke of Sutherland, 422,000 acres; M. Ellerhousen, 600,000 acres; and eighteen others, whose landed possessions in this country aggregate about 2,000,000 acres.

NEW YORK'S MOVING STAIRWAYS

The inconvenience and fatigue growing out of the congestion of passengers at the elevated railroad stations in New York have at last led to the construction of moving stairways at some of the busiest points of ingress to the trains. These escalators, as they are called, carry passengers up to the cars and thus greatly relieve the pressure of the hurrying throng. The operation of the escalators is indicated by the accompanying illustration.



A FARM WORKED BY CRAZY FOLK

The Green County, Wisconsin, "poor farm" is operated by the inmates of the insane asylum of that county.

STRAIT-JACKETS.

There are no strait-jackets here. A "maniac" is unknown. Sometimes they are brought here, but they never remain, as maniacs. There are no dungeons and no cells for raving men and women, who have lost out in the struggle. But there is something in the atmosphere of the place—a feeling of calm and peace—that has done more for the restoration of reason to the distracted ones than strait-jackets and their advocates ever thought of. The maniac speedily becomes the patient. As such he is taught to bear some part in the duties of the place, and thus is made once more a useful member of society. It is generally usefulness that awakens the forgotten sense of dignity, memory and other things that go to make men and women out of incurables.

REASON RETURNS.

Sometimes it is merely the picking up of chips that calls back the unfortunate one's

interest in life. Sometimes it is the reluctant turning of a grindstone. Sometimes it is a little yellow, helpless canary, whose very littleness and helplessness appeal to the dormant spark in some wreck of a woman whose reason has lost its bearings. Sometimes it is one thing and sometimes another, but nearly always it is this single principle that is used to call back the memories and powers that have gone. The patients are made to feel that something depends on them. They are not outcasts and crazy people.

RESTRAINTS.

The restraints to which they have been used in most cases are taken away. Men have been brought there raving, taking four strong assistants to hold them, and yet in a few hours the evil spirit that rent them somehow felt the power that lies in the methods of the place. Confinement, straps and their like are absolutely unknown.

The institution is self-supporting. In connection with the asylum—which does not carry any suggestion at all of that grim thing—is the county poor farm. The men and women in this department are generally past the working time, and are the greatest burden on the place. The insane are taught to work. They sow, they reap, they do all the farm labor, including the care of the cattle and horses and the teaming itself. They do much of the carpenter work and in other ways are made to help themselves and to help others.

A UNIQUE REPORT.

One of the superintendent's reports to the state authorities is almost unique, and is remarkable chiefly for its blanks: "Transferred to other institutions, none; number escaped and not returned, none; under restraint or seclusion one month or more at a time, none; temporarily in restraint or seclusion, none; total number days restraint, none."

On the contrary, out of a total number of 134 patients, seven were discharged as sane, and three were paroled and not returned. Thirty-two out of the men and twenty-three of the women work all day regularly. Thirty-three in all work half a day or more, regularly; sixteen work less. Only thirty do no work at all, and just thirty are classified as "physically disabled otherwise, aside from their mental disability," so that every patient physically able works to a greater or less extent every day.

Green County folks have learned to speak of the institution as the "farm" rather than as the asylum. The farm consists of 320 acres, and 200 of these are under cultivation. All the work, even the teaming, is done by "crazy people." No less than forty of them go about their work like any other "hands," absolutely without watching, and among the very few attendants the same rule of calmness and kindness is in force.

COINS OF THE BIBLE

THE SHEKEL.

The first mention of the use of silver in the Bible is in Genesis xx: 16. In Genesis xxiii: 16, its use as money is distinctly mentioned, in the denomination of shekel, which was the unit of Jewish calculations.

"And Abraham weighed to Ephron the silver which he had named in the audience

of the sons of Heth, four hundred shekels of silver, current money with the merchant." Thus, money has formed the basis of commercial intercourse from the earliest stages. The metals most commonly mentioned as used for this purpose are gold, silver and copper.

MONEY OF EGYPT AND CANAAN.

Throughout the Old Testament the money of Egypt and Canaan is mentioned without distinction, leading to the conclusion that the money of the two countries, if not the same, was interchangeable.

RINGS AS MONEY.

Old Egyptian inscriptions give representations of money in the form of rings, which did not represent any fixed amount, but had to be weighed. Silver was probably the earliest and therefore, the standard, representative of value, and the shekel was the common denomination. It was often called a "piece of silver."

THE BEKA.

The first allusion to Jewish coinage is found in the Apochrypha, where it is related, in I Maccabees xv: 6, that Simon was granted permission to coin money with his own stamp, and he probably issued the first distinctive Jewish coins, the silver shekel, and the half shekel, called the beka. The standard or sacred shekel was kept in the sanctuary, and by this the coinage was regulated. The coins in use in the Biblical period were as follows: The coins of Crotona, Boetia, Berea, two Syracusan pieces, Acanthus, Phocis Thessalonica, Egina, Herod's shekel, another Berean coin, the Patera, Athens, two Pisistratus coins, the Magnesia, Antiochus Dionysius, Corinth, Antiochus Epiphanes, coin of Macrinus, Byblos, Syria, and of Tigranes, King of Syria.

ABOUT PEANUTS

WHERE GROWN.

The peanut is grown mostly in Southampton, Surrey, Prince George, Nansemond, Sussex, Isle of Wight, Princess Anne and Norfolk counties, in Virginia, and in Currituck county, North Carolina. The nuts differ greatly in quality and flavor, and the finest come from Nansemond and Isle of Wight counties in Old Virginia.

Although they grow on vines, the nut is developed under the ground.

PEANUT FACTORIES OF NORFOLK.

The peanut factories of Norfolk, Virginia, which handle more than a million bushels per year, furnish an interesting study of the methods of preparing this humble but popular little edible for the market.

CLEANING.

The nuts are separated, cleansed and classed as follows, each machine having a duty to perform: First, there is a large cylinder in which all the nuts are placed in order that the dust may be shaken off from them. They pass thence to the brushes, where every nut receives fifteen feet of a brushing before it becomes free. Then they pass through a sluiceway to the floor below, where they are dropped on an endless belt which is about two and a half

feet in width, and passes along at the rate of four miles an hour.

SORTING.

On each side of the belt stand eight colored girls, and as the nuts fall from the sluice onto the belt, the girls, with a quick motion of the hand, pick out all the poor looking nuts. Two-thirds are thus picked off before the belt reaches the end, and only the finest pass the crucible. These drop through another sluice into bags on the floor below.

They are taken away by hand, sewed up, branded as "cocks," and stamped with a rooster.

"SHIPS," "EAGLES" AND "CHIPS."

The nuts caught up by the girls are thrown to one side, placed in bags and taken to another room, where they are picked over, and the best are singled out and branded as "ships." The third grade, called "eagles," is picked from the cullings of the "cocks" and "ships," bagged and sent to another floor. There the nuts are shaken out of the shell by a patent sheller, placed in 200-pound sacks and shipped to the North for use of the confectioners.

A PECULIAR OIL.

A peculiar kind of oil is extracted from the meat of the nut, in which the wholesale druggists deal largely.

THE SHELLS.

The shells are packed in sacks and sold to stablekeepers for horse bedding. A peanut factory of average size cleans, picks and packs about 3,000 bushels per day.

LARGEST APARTMENT HOUSE IN THE WORLD

The Ansonia, a 17-story structure, which occupies an entire block on Broadway, New York, between 73d and 74th streets, is said to be the largest apartment building in the world.

TWENTY-FIVE HUNDRED ROOMS ABOVE THE GROUND.

Some idea of the magnitude of the hotel may be formed from the fact that it contains no less than 2,500 rooms above ground, and consumed more than three years in its construction.

THE BASEMENT.

The building is supplied with many modern and novel arrangements for heating, ventilation, and the supply of hot and cold water. The basement is a veritable repository of 20th-century inventions. Here are a storage, repair and charging room for automobiles; a grocery, where everything in the line of edibles and household necessaries may be obtained by the tenants at current prices; a meat market, bakery, milk depot, barber shop, laundry, ladies' hair dressing and manicuring parlors, safe deposit vaults, cold storage rooms for furs, and other conveniences. There is also one of the largest swimming pools in New York, which it is intended to use for a swimming school.

HIGH RENTALS.

The cheapest bachelor suites in the building rent for $600 a year, and consist of one room and a bath. The family apartments range in size from five to fourteen rooms, with bath, and the rent varies from $1,500 to $6,000 a year. These are rates for unfurnished rooms, and give a pretty good idea of the cost of living in style in the metropolis.

CHRONOLOGY OF ELECTRICAL DISCOVERIES

Alessandro Volta discovered the electric current, 1800.

Sir Humphrey Davy produced an arc light, 1810.

Induction discovered by Faraday, 1831.

First electric road built by Thomas Davenport, of Brandon, Vermont, 1885.

Automobile invented by Davenport, 1885.

Wheatstone and Cooke invented a system of telegraphy, 1835.

Zinc-copper battery invented by Daniell, 1835.

Submarine cable laid across the Hoogly river, 1839.

First Morse telegraph line constructed, 1844.

Royal House discovered method for printing by telegraph, 1846.

Automatic repeaters invented, 1848.

First long submarine cable laid in British channel, 1850.

First successful Atlantic cable laid, 1858.

James Elkington invented system of electrolytic copper refining, 1865.

Stearn's duplex telegraph system introduced, 1872.

Edison introduced a quadruplex system, 1874.

First modern electric road built by George F. Greene, of Kalamazoo, Michigan, 1875.

Telephone invented by Bell and Gray, 1875.

Continuous current dynamo discovered by Gramme, 1876.

First telephone exchange operated at New Haven, Connecticut, 1878.

Incandescent lamp invented by Edison, 1879.

First central lighting station established in New York, 1880.

Storage battery, or accumulator, invented by Planté, 1882.

First practicable trolley line built by J. C. Henry at Kansas City, Missouri, 1884.

The Siemens brothers built the first European electric road in Berlin, 1884.

Electricity first used on elevated roads in New York, 1885.

First long-distance, high-voltage power-transmission plant installed at Pomona, California, 1892.

Telautograph invented by Elisha Gray, 1893.

Heavy trains moved by electric locomotive in Baltimore, 1895.

The X-ray discovered by Dr. Wilhelm Konrad Roentgen, 1895.

Road automobile came into general use, 1897.

Wireless telegraphy developed by Guglielmo Marconi, 1899.

Transatlantic telephony made possible by Dr. I. M. Pupin, 1900.

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DERIVATION OF WORDS STANDING FOR MONEY

The derivations of the words standing for money and coinage are interesting and instructive. "Pecuniary" takes us back to the times when values were reckoned by so many head of cattle (pecus). The word "money" is from "moneta." Money being so called because coins were first regularly struck in the temple of Juno Moneta, which again was derived from monere, to warn, because it was said on the spot where Manlius heard the Gauls approaching to the attack on the city. Coin is probably from the Latin "cuneus," a die or stamp.

NAMED FROM THEIR WEIGHT.

Many coins are primarily so called from their weight, as, for instance, our pound, the French livre and the Italian lira; others, from the metal, as the "aureus;" the rupee, from the Sanskrit "rupya," silver; others from the design, as the angel; the testoon, from teste or tete, a head; others from the head of the state, as the sovereign, crown; others from the proper name of the monarch, such as the daric, from Darius, the Philip, Louis d'or, or the Napoleon.

THE DOLLAR.

The dollar, or thaler, is short for the Joachimsthaler, or money of the Joachims thaler, in Bohemia, where these coins were struck in the 16th century. Guineas were named after the country from which the gold was obtained; and the "franc" is an abbreviation of the inscription "Francorum Rex." The "sou" is from the Latin, solidus.

THE SHILLING.

The word "shilling" seems to be derived from a root signifying to divide. In several cases the name indicates the fraction of some larger coin as the denarius, half penny, farthing, cent and mill.

The pound was originally not a coin, but a weight and comes from the Latin, pondus. Our pound was originally a pound of silver, which was divided into 240 pennies. The origin of the word penny is unknown. Some have derived it from pendo, to weigh.

STERLING.

Our word "sterling," is said to go back to the time of the conquest. Some have supposed that it was first attributed to coins struck at Stirling; others, that the name was derived from coins having a star on the obverse. The most probable suggestion is that it has reference to the Easterling or North German merchants.

HOW SPECTACLES ARE MADE

The white lens in use in the ordinary spectacle of commerce is made of the common window pane glass rolled in sheets: sometimes it is made into balls. From these are cut pieces of from 1 1-4 to 1 1-2 inches in size, which are taken into the

grinding room, and each piece is cemented separately upon what is called a lap, of a semi-circular shape.

THE PROCESS OF GRINDING.

These are made to fit into a corresponding curve or saucer, into which fine emery powder is introduced, and subjected to a swift rotary motion. The gradual curve in the lap gives to the glass as it is ground a corresponding shape, until the desired center is reached; the lap is then taken out and subjected to warmth, which melts the cement sufficiently to permit the glass being removed and turned upon the opposite side, when the same process is renewed.

THE PROCESS OF SHAPING.

This being completed, the lenses are detached again from the lap and taken to another department, where they are shaped to fit the frames. This is accomplished by a machine of extreme delicacy. Each piece of glass is put separately upon a rest, when a diamond is brought to bear upon it, moving in the form of an oval, thus cutting the desired size; but the edges, of course, are rough and sharp and must be beveled.

BEVELING.

For this purpose they are turned over to another set of hands, mostly girls, who have charge of the grindstones, which are about six inches in thickness. Each operator is provided with a gauge. The glass is taken between the forefinger and thumb, and held sufficiently sidewise to produce half the desired bevel. When this is attained it is again turned, and the other side of the bevel completed. During this process it is constantly gauged in order to be sure that the frame will close upon it without too much pressure, which would break the lens.

FOCUSING.

The next process to which the lens is subjected is that of focusing, and it requires extreme care. The person having this department to attend to is placed in a small room, alone. Across the entrance is hung a curtain, which is only drawn aside sufficiently to admit the required amount of light from a window several feet away.

Upon one of the top panes of the window is placed a piece of heavy cardboard, with a small hole cut in the center, representing the bull's eye of a target. Through this the rays of light shine upon the lens in the hands of a workman, and are reflected through it to a dark background. The lens is then moved back and forth upon an inch measure, until the proper focus is attained. Say, for instance, the extreme end of the measure is 62 inches, the lens is placed at that, but does not focus; it is gradually moved along, inch by inch, until, perhaps, it is brought to 36 inches.

NUMBERING.

At this the proper center, or focus, is attained, and it is then numbered 36. The same operation is of course necessary with every lens. This accounts for the numbers which are upon spectacles, or glasses of any kind, when purchased.

THE OLDEST NEWSPAPER IN THE WORLD

The Peking *Gazette,* the oldest periodical in the world, has an estimated circulation of more than 100,000. It has ten publishers in Canton, each of whom employs about ten distributors, so that there are 100 distributors in the city and suburbs alone.

The *Gazette* is printed from movable types, and each publisher takes a certain number of copies. It is delivered every two days to subscribers, who are of two classes. The first retain the pamphlet and pay about 20 cents a month; the second pay about half that sum, and return the *Gazette* to the distributor the next time he comes around. Together with it is delivered the local "official sheet," the matter of which is collected from the yamens daily. This is printed from wax blocks, which are then re-melted and are available for another day's issue.

THE OLDEST MANUSCRIPT IN EXISTENCE

This production, entitled, "De Imitatione," in the handwriting of Thomas á Kempis, was finished in 1441. It was saved from the ruins of the monastery of St. Agnes on the Nemelenberg, destroyed during the revolt of the Netherlands. Johannes Latomus, prior of the Monastery of the Throne was the means of its salvation, in 1557.

By Latomus the manuscript was carried to Antwerp and left at his death to a friend, Jean Bellere, a man of letters. On his death, in 1595, his sons became possessed of the treasure and turned it over to the Jesuits. On the suppression of that order. "De Imitatione" passed into the possession of the Burgundian Library at Brussels. That this work is the production of Thomas á Kempis has been vigorously disputed by some, but certain peculiarities of the manuscript seem to dispose of this contention. These are found in a system of punctuation characterizing the undoubted writings of this author, the object of which is to divide the work into rythmical periods. These marks are as follows: the full stop. followed by a small capital; the full stop, followed by a small letter; the usual sign of interrogation; and lastly, an unusual sign, the clivis, or flexa, used in the musical notation of the period. When the Latin is read with due attention to these marks, a distinct melody is perceptible.

FAMILIAR MAXIMS AND THEIR ORIGIN

Many of our common sayings, so trite and pithy, are used without the least idea from whose mouth or pen they first originated.

SHAKESPEARE.

The works of Shakespeare probably furnish us with more familiar maxims than those of any other writer. To him we owe: "All is not gold which glitters," "Make a virtue of necessity," "Screw your courage to the sticking place," "They laugh that win," "This is the short and long of it," "Comparisons are odious," "As merry as the day is long," "A Daniel come to judgment," "Frailty, thy name is woman," and a host of others.

WASHINGTON IRVING.

Washington Irving gives us "The Almighty Dollar." Thomas Morton queried long ago "What will Mrs. Grundy say?" while Goldsmith answers "Ask me no questions and I'll tell you no fibs." Charles C.

Pinckney gives us "Millions for defense, but not one cent for tribute."

GENERAL HENRY LEE.

"First in war, first in peace, and first in the hearts of his countrymen" was written, in 1790, by General Henry Lee. He also originated "Make assurance doubly sure," "Count their chickens ere they're hatched," "Christmas comes but once a year," and "Look before you leap."

Thomas Tasser, a writer of the 16th century, gives us "It's an ill will turns no good," "Better late than never," "Look ere thou leap" and "The stone that is rolling can gather no moss." "All cry and no wool" is found in Butler's Hudibras.

DRYDEN.

Dryden says, "None but the brave deserve the fair," "Men are but children of a larger growth," and "Through thick and thin." "No pent up Utica contracts our power" came from Jonathan Sewen.

NATHANIEL LEE AND MATTHEW PRYOR.

"When Greeks join Greek then comes the tug of war" came from Nathaniel Lee in 1692. Matthew Prior said, "Of two evils I have chosen the least,"—and "The end must justify the means."

We are indebted to Colley Cibber for "Richard is himself again." Johnson tells us of a "Good hater," and Mackintosh, in 1791, used the phrase, "Wise and masterly inactivity."

COWPER AND THOMAS a' KEMPIS.

"Variety's the very spice of life," and "Not much the worse for wear," are the words of Cowper; and "Man proposes, but God disposes," those of Thomas á Kempis.

MILTON.

Christopher Marlowe, wrote "Love me little, love me long," and Edward Cook opined that "A man's house is his castle." Milton originated the expressions, "A paradise of fools," "A wilderness of sweets," and "Moping melancholy and moon struck madness."

Edward Young tells us that "Death loves a shining mark," "A fool at 40 is a fool indeed," and "Man wants but little, nor that little long." Bacon said "Knowledge is power," and Thomas Southern originated the phrase "Pity's akin to love."

Dean Swift said, "Bread is the staff of life"; Campbell said, "Coming events cast their shadows before," and "Distance lends enchantment to the view." Keats said, "A thing of beauty is a joy forever"; Franklin said, "God helps them who help themselves"; Lawrence Sterne said, "God tempers the wind to the shorn lamb."

ABOUT WATER

Water is found in four separate states or forms, as ice, water, vapor, and in combination with other substances. As a rule, all bodies contract in cooling, but water increases in bulk and becomes lighter as it gets cooler.

Although water in freezing becomes intensely cold, cold water and cold sulphuric acid mixed in certain proportions, become intensely hot.

IN THE FORM OF VAPOR.

Water is heavier than air, and yet, mixed with the air in the form of vapor, it occupies

a space 1,400 times greater than it did in its ordinary liquid state.

A cubic inch of water will make nearly a cubic foot of steam.

Water in the shape of steam at low pressure will scald and blister the hand, but at high pressure, and with double heat, it will not scald or blister.

WATER FROM THE THAMES.

Under certain circumstances water will change its condition without any apparent cause. Ships leaving the port of London take their water from the Thames, and it is said to have some peculiar properties which render it fit for long sea voyages. After a few weeks, or less, it turns putrid and offensive; then it changes its character altogether, becomes pure and palatable, and is better than any other water for sea stock.

THE RHONE WATER.

Water from the Rhone, if allowed to settle and then put into earthen vessels, will remain fit for use a long time. In imperial Rome there was a good supply of water. The allowance for each inhabitant was 300 gallons daily.

CROTON WATER.

Croton water (New York) is remarkably free from impurities, as it contains less than five grains of organic and inorganic matter per gallon; the water in Philadelphia contains less than four grains.

SPRING WATER IN PORTUGAL.

In some parts of Portugal the spring waters are so hard as to be quite useless for many purposes.

WELL WATER IN EDINBURGH.

The well water in Edinburgh is so soft that soap may be dissolved in it, and it will still remain transparent.

ODD EFFECT OF IRON IN WATER.

Iron in water will give a bleacher of cloth no end of trouble. A woman in Scotland who bleached her own household linen, after watering some webs near her home, was amazed to find that they became redder and redder every day. She attributed this to witchcraft, blamed the person she hated most, and sold the cloth for a trifle. The water was afterward found to contain a large amount of iron.

Water is liable to become contaminated by lead, and cases of lead poisoning often occur when lead in water is exposed to the air. The carbonic acid of the air attacks the lead and water, acting upon it in that state, makes the lead soluble. Water conveyed in leaden pipes to a fish pond will kill the fish.

THE DEADLY SNAKES OF INDIA

ANNUAL AMOUNT PAID FOR SNAKE-KILLING.

The amount of rewards paid in a single year for the destruction of wild beasts and venomous snakes in India, was 99,189 rupees.

THE CHAIN VIPER.

Three specimens of snakes dangerous to human life are to be met with in the Bombay Presidency, viz.: the cobra, the chain viper and a small, black, white-banded snake, known to naturalists as the Bungarus Aren-

atus. Popular Anglo-Indian tradition adds others, such as the carpet snake, the whip snake, the eye snake, etc.

THE COBRA.

The cobra, one of the commonest snakes in India, is one of the most fatal in the world. It is estimated that there are more than 1,000 for every square mile. In stations in the Deccan, as, for instance, Poona, the cobra finds board and lodging, on easy terms, in the holes of the field rats, and there serves a useful purpose.

SNAKES FEAR MAN.

Snakes shun man far more than man shuns them, and the cobra is especially timid and wary in disposition.

NUMBER KILLED BY SNAKE-BITES IN A SINGLE YEAR.

According to statistics, the number of persons killed in India by venomous snake bites was 16,812 in a single year.

OLD CLOCKS AND WATCHES

In his "Hyperion," Longfellow tells us that in the belfry of the Kauthaus in Coblenz is a huge head, with a brazen helmet and a beard, and whenever the clock strikes, at each stroke of the hammer this giant's head opens its great jaws and smites its teeth together as if it would say: "Time was—Time is—Time is past!"

THE "MAN IN THE CUSTOM HOUSE."

This figure is known in all the country round as the "Man in the Custom House," and when a friend from the country meets a friend from Coblenz, instead of saying: "How are all the good people in Coblenz?" he says, "How is the man in the Custom House?"

A REMARKABLE CLOCK IN PRAGUE.

Another very remarkable clock is found at Prague, near the old Hussite church. The clock itself forms part of the original tower, while the face or dial is exposed to the street. This dial is six or eight feet in diameter, and has a great number of hands, recording hours, minutes, days, months, years, and even centuries. The dial is set in an elaborate framework, about eight feet high and fifteen feet long, and this metal framework is ornamented with many curious and quaint devices. One of these is connected with the striking of the hours.

A WONDERFUL CLOCK IN VENICE.

On the dial of a wonderful clock in St. Mark's Cathedral, Venice, the twenty-four hours are marked with the signs of the zodiac and the phases of the moon. Above this is the Madonna, sitting in state upon a platform between two doors.

ON GRAND RELIGIOUS FESTIVALS.

On grand religious festivals, the door on the right hand of the Virgin opens and out walks an angel with a big trumpet, which he blows, and bowing to the Madonna, passes on. He is then followed by three men representing the three wise men of the East, one of whom is as black as night. These all pause and bow before the Virgin, and then pass through the door on her left, which closes after them. On the platform is a huge bell, beside which stand two giant figures, who strike the hours with sledge hammers, while above all is the Lion of St. Mark.

AN OLD JAPANESE TIMEKEEPER.

In Japan is an old timekeeper of remarkable construction. This clock, in a frame three feet high and five feet long, represented a noon landscape of great loveliness. In the fore ground were plum and cherry trees and rich plants in full bloom; in the rear was a hill, gradual in ascent, from which flowed a cascade, elaborately imitated in crystal. From this point a thread-like stream glided along, encircling in its windings, rocks and tiny islands, but presently losing itself in a far-off stretch of woodland. In the sky turned a golden sun, indicating, as it passed, the striking hours, which were all marked upon the frame below, where a slowly creeping tortoise served as a hand. A bird of exquisite plumage, resting on a plum tree branch, by its wings proclaimed the expiration of each hour. When the song ceased, a mouse sprang from the grotto nearby, and, running over the hill, disappeared.

THE CLOCK AT GENEVA THAT EXCELLED ALL OTHERS.

Droz, a mechanic of Geneva, produced a clock which excelled all others in its marvelous construction. On it were seated a negro, a shepherd and a dog. When the clock struck, the shepherd played six tunes on his flute, and the dog approached and fawned upon him. The King of Spain came to see this wonderful invention, and was delighted beyond measure. "The gentleness of my dog," said Droz, "is his least merit: if your majesty touch one of those apples which you see in the shepherd's basket, you will admire the animal's fidelity." The king took an apple, upon which the dog flew at his hand, barking so loudly and so naturally that another dog which had come into the room, began to bark also.

TERRIFIED COURTIERS.

The courtiers became terrified, deeming it witchcraft, and crossing themselves, hastily departed. Droz requested the only one who ventured to remain, to ask the negro what time it was. He did so in Spanish, receiving no reply. Droz remarked that the negro had not learned Spanish, whereupon the question was repeated in French, and the negro immediately replied. This frightened the questioner also, and he, too, beat a hasty retreat, sure that the whole thing must be of the devil.

THE WATER CLOCK.

The first clock of which we have any account was invented in Alexandria, Egypt, about 245 B. C. One hundred years later the water clock, a very rude and imperfect timepiece, was introduced into Rome. The water issued drop by drop through a hole of the vessel and fell into another, in which a light body that floated marked the hight of the water as it rose, and by these means indicated the time that had elapsed. At first the water flowed out rapidly, so that the clock required much regulation.

WEIGHTS AND WHEELS.

With slight variations in form of construction, the water clock served the purposes of mankind for more than a thousand years, and not until the eleventh century did clocks moved by weights and wheels appear in Europe, at first in the monasteries. Some of them were very costly.

THE SALADIN OF EGYPT TO THE EMPEROR, FREDERIC.

In 1232, the Saladin of Egypt sent to the Emperor, Frederic a clock worth 5,000 ducats. It resembled a celestial globe, in which figures of the sun, moon and other

skill, were impelled by weights and wheels, performing · their courses in certain fixed intervals.

In about 200 years the common people began to want to know the "time o' day," and clocks were placed in the towers of public buildings. Among these were many wonderful examples of mechanical skill and ingenuity, that at Strassburg being especially noteworthy.

THE STRASSBURG AND PADUA CLOCKS.

Strassburg had its first public clock in the year 1370; Padua, some time in the 14th century; Courtray and Dijon, in 1382. There was little improvement in clocks until the middle of the 17th century.

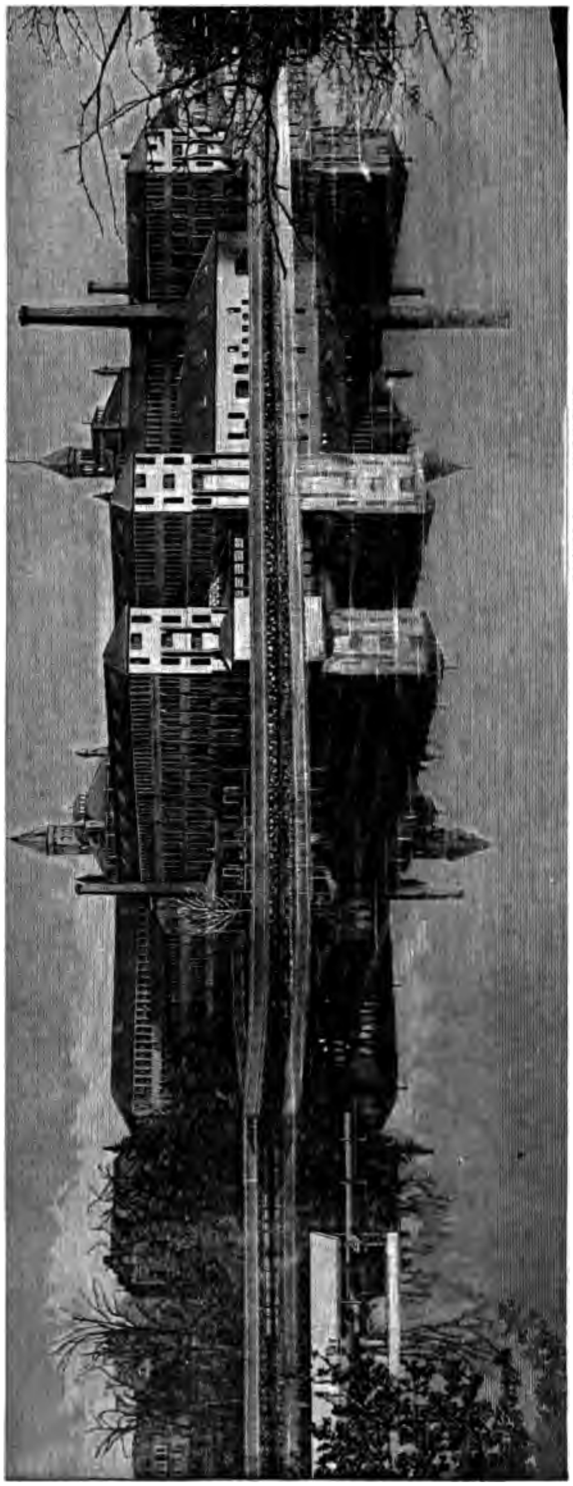
ELI TERRY'S WOODEN CLOCK.

Eli Terry of Plymouth, Massachusetts, made the first wooden clock in 1793.

WATCHES.

The watch dates from about the middle of the 16th century, the first being very cumbrous. The opposite extreme in size was reached 150 years later.

In 1764, John Arnold completed and presented to George III a watch three-fifths of an inch in diameter, perfect in all its parts, and repeating the hours, quarters and half quarters. Its size was that of a silver two-pence, and its weight, that of a sixpence.



Courtesy of American Waltham Watch Co.

REAR VIEW AMERICAN WALTHAM WATCH CO., WALTHAM, MASS.

Organized 1852. The company has manufactured and delivered since then 12,000,000 watches.

WHAT CRIME COSTS THE PEOPLE

Putting into actual figures the annual cost of detecting, punishing, and preventing crime, Chicago, Illinois, and Cook County, in which it is located, are used as an illustration of the manner in which the money is applied. The police force, with its 3,000 men, leads:

Police department	$3,500,000	
BRIDEWELL.		
City's portions	$175,000	
Country portion	18,000	
		$193,000
Criminal Courts:		
Conduct	$45,000	
Supplies	$20,000	
		$65,000
STATE'S ATTORNEY.		
Office	$50,000	
Supplies	4,500	
		54,500
Jail		40,000
City Police Courts		10,000
Juvenile Court (preventive measures)		2,500
For locks, bolts and wires, watchmen and special policemen		250,000
Total		$4,115,000

HISTORY OF THE WEEPING WILLOW

The weeping willow tree came to America through the medium of Alexander Pope, the poet, who planted a willow twig at his Twickenham villa, on the banks of the Thames. The twig came to him in a box of figs sent from Smyrna by a friend, who had lost his all in the South Sea bubble, and had gone to that distant land to recoup his fortunes. A young British officer, who came to Boston with the army sent to crush the rebellion of the American colonies, brought with him a twig from Pope's now beautiful willow tree, intending to plant it in America when he should comfortably settle down on lands confiscated from the conquered Americans. The young officer, disappointed in these expectations, gave his yellow twig, wrapped in oil silk, to John Park Custis, son of the wife of George Washington, who planted it on his Abingdon estate in Virginia. It thrived and became the progenitor of our willow trees.

THE BEGINNING OF CERTAIN THINGS

Envelopes were first used in 1839.

Anæsthesia was discovered in 1844.

The First Steel Pen was made in 1830.

The First Air Pump was made in 1654.

The First Lucifer Match was made in 1829.

The First Balloon Ascension was made in 1783.

The First Iron Steamship was built in 1830.

Ships were first "copper bottomed" in 1783.

Coaches were first used in England in 1569.

The First Horse-Railroad was built in 1826-7.

The Entire Hebrew Bible was printed in 1488.

Gold was first discovered in California in 1848.

The First Steamer plied the Hudson in 1807.

The First Watches were made at Nuremburg in 1477.

Kerosene was first used for lighting purposes in 1826.

The First Newspaper Advertisement appeared in 1652.

The First Copper Cent was coined in New Haven in 1687.

The First Telescope is said to have been used in England in 1608.

The First Sawmaker's Anvil was brought to America in 1819.

The First Locomotive used in America was placed in service in 1829.

The First Almanac was printed by George Van Purbach in 1460.

The First Chimney was introduced into Rome from Padua in 1329.

Glass Windows were first introduced into England in the eighth century.

The First Steam Engine was brought to America from England in 1753.

The First Complete Sewing Machine was patented by Elias Howe, Jr., in 1846.

The First Society to promote Christian knowledge was organized in 1698.

The First Manufacture of Pins in America was soon after the War of 1812.

Glass Beads were found on mummies over 3,000 years old.

Gas was first used to illuminate in 1702, and first used in New York in 1827.

The First Glass Factory in the United States was built in 1780.

The First National Bank in the United States was incorporated December 31, 1781.

The First Temperance Society in the United States was organized in Saratoga, New York, in 1808.

The First Machine for Carding, roving and spinning cotton in the United States, was manufactured in 1786.

The First Society for the Circulation of the Bible was organized in 1805.

The First Telegraph Instrument was operated by S. F. B. Morse in 1835.

The First Union Flag, with 13 red and white stripes and the English cross in one corner, was unfurled over the camp at Cambridge, Massachusetts, January 1, 1776.

The First Daily Newspaper appeared in 1702.

The First Newspaper in the United States was published in Boston, September 25, 1790.

The First Religious Newspaper, the "Boston Record," was published in 1815.

The "Shoe Black" first came into vogue in 1750.

THE TAHITIAN'S FIRST GLIMPSE OF NAILS.

When Captain Cook first visited Tahiti, the natives were using nails made of wood, bone, shell and stone. When they saw iron nails, they fancied them to be shoots of some very hard wood, and being desirous of securing such a valuable commodity, they planted them in their gardens.

THE RELIGIONS OF THE WORLD

Learned men estimate that there are at least 1,000 forms of religious worship practiced in the world to-day. These may be classed under four great heads, viz.: the Pagan, the Mohamedan, the Jewish and the Christian. Of these, the chief Pagan religions now existing are: Fetichism, Brahmanism and Buddhism, Confucianism, Taoism and the primitive religion of the North American Indians.

The number of followers of Christianity is estimated at 506,000,000, with 800,000,000 followers of the other creeds. Thus it is that Christianity claims nearly two-thirds as many as the other sects combined.

CURIOSITIES OF THE BIBLE

The Bible bears no date. It comprises 66 documents, or books, and is supposed to have been written by 40 men. The Book of Isaiah has 66 chapters. There are 54 miracles recorded in the Old Testament, and 51 in the New Testament.

SHORTEST AND LONGEST VERSES.

The shortest verse in the Bible is John xi: 35, "Jesus Wept." In point of words, but not of letters, another verse is equally short, viz.: Thessalonians, v: 16, "Rejoice Evermore." The longest verse is the ninth verse of the eighth chapter of Esther. Esther is the only book in which the Deity is not mentioned.

NUMBER OF CHAPTERS, WORDS AND LETTERS.

The Bible contains 3,566,480 letters, 773,746 words, 31,173 verses, and 1,189 chapters. The word, "Lord," occurs 1,855 times, and the word, "and," 46,277 times. The word, "Reverend," occurs but once, and then in the ninth verse of the 111th Psalm. The middle verse in the Scriptures is the eighth verse of the 118th Psalm. The 21st verse of the seventh chapter of Ezra contains all the letters of the alphabet, with the exception of the letter "J." In the Bible, are no words or names with more than six syllables.

THE WORLD'S NEWSPAPERS

In 1775, there were only 27 newspapers published in the United States. Now there are 18,657 in America; 7,000 in Germany; 9,000 in Great Britain; 4,300 in France; 1,976 in Japan; 1,500 in Italy, and the remainder are distributed throughout Australia, Spain, Switzerland, Holland, Belgium, Asia and Canada, the total number in the world being 51,234.

The oldest newspaper in the United States, called the "Pennsylvania Gazette," is published at Philadelphia, and was established by Samuel Kreimer, in 1728.

LARGEST BELL IN THE WORLD

To Kremlin, Moscow, belongs the credit of having the largest bell in the world. This bell has a circumference of 68 feet at the bottom, and is 21 feet in height. Its greatest thickness is 23 inches, and it weighs 443,772 pounds. It has never been rung, and was evidently cast where it now rests.


BIG BELL AT CHIONIN, KIOTO.

HIGHEST VOLCANO IN THE WORLD.

Popocatepetl (smoking mountain), 35 miles southwest of Pueblo, Mexico, is the tallest volcano in the world. It is 17,748 feet above the sea level, and has a crater three miles in circumference, and 1,000 feet deep.

LARGEST THEATER IN THE WORLD.

The new opera house in Paris, France, is the largest in the world. It covers nearly three acres of ground; its cubic dimensions are 4,287,000 feet, and it cost about $100,-000,000.

LARGEST CAVERN IN THE WORLD.

The Mammoth Cave, in Edmondson county, Kentucky, is the largest cavern in the world. The cave consists of a succession of irregular chambers, several of which are large, situated on different levels. Some of these are traversed by navigable branches of the subterranean Echo river. Blind fish are found in these waters.

GROWTH OF THE GREAT POWERS

The comparative numerical strength of the principal nations of the world has undergone many revisions during the last 103 years. In 1800, the great powers were thus grouped:

Russia, 38,140,000 population; France, 27,720,000; Germany, 22,330,000; Austria, 21,230,000; the United Kingdom, 15,570,000; Italy, 13,380,000; Spain, 10,440,000; the United States, 5,310,000.

In the year 1902, we had the following figures:

Russia, 130,896, 628; the United States, 79,725,456; Germany, 53,000,000; Austria-Hungary, 42,600,906; the United Kingdom, 49,559,954; France, 38,517,-975; Italy, 31,000,000; Spain, 18,250,-000.

ENGLISH-SPEAKING RACES.

Of this population, the English-speaking races in Great Britain and Ireland, together with the English-speaking colonies, and the United States, number 133,109,-543, as against Russia's 130,896,628.

LOCOMOTIVE WORKS, LOCOMOTIVES AND CARS

There are 28 locomotive works in the United States, and they represent a capital of $40,813,793. The value of their products for 1902 was $36,107,145, to produce which involved an outlay of $11,745,524, for wages; $1,243,350, for miscellaneous expenses; and $21,175,420, for materials used.

NUMBER OF LOCOMOTIVES BUILT IN 1902.

At the 28 establishments 2,962 locomotives of all classes were built, aggregating a value of $28,345,256, compared with 2,409 locomotives, valued at $19,752,465, built in 19 establishments in 1890. In addition to these, 272 locomotives were constructed at 26 railroad shops, which were valued at $3,276,393.

INCREASE IN COST OF CONSTRUCTION.

During the last ten years there has been a considerable increase in the cost of locomotives built. In 1890 an average locomotive cost $8,199; in 1902 the average price was $9,956. The increased price in construction is due to increased size and the materials used. In construction, Penn sylvania was first, with a record of 49.3 per cent of the whole, with New York state a close second, and New Jersey, third.

TOTAL NUMBER OF LOCOMOTIVES AND CARS IN 1902.

The number of locomotives in the United States in 1902 was 39,584; the total car equipment, 1,550,833; and the total number of railroad employes, 1,071,169.

TOTAL MILEAGE OF TRACK.

The United States had at the same period, 195,571 miles of main track; 12,845 miles of second track; 1,154 miles of third track; 876 miles of fourth track; and 54,920 miles of yard track and sidings,—a total of 265,366 miles of single track.

TOLD IN FIGURES

THE NEW YORK RAPID TRANSIT TUNNEL.

Timber and lumber costing $2,000,000 were used in the preparatory work in the New York rapid transit tunnel.

AGRICULTURE IN COLORADO.

Colorado cultivates about 2,500,000 acres of land, and has nearly 15,000 miles of irrigating canals and ditches. Its agricultural products exceed by far the mineral.

EAT NO MEAT.

At least seven-tenths of the population of the globe never eat flesh meat. In India, China, Japan, and adjacent countries, there are about 400,000,000 people who eat no flesh meat.

THE NORTH AMERICAN INDIANS.

Of the 85,000 Indians in the five civilized tribes, Cherokees, Creeks, Choctaws, Chickasaws, and Seminoles, less than 15,000 are full bloods, so the Indian will soon lose his racial identity.

VICTIMS OF ELECTRIC STREET CARS.

Electric street cars killed 1,216 persons and injured 47,428 in twelve years,—from the time they came into use until 1903. The number of passengers carried in a year has increased from 2,000,000,000 to 5,000,000,000.

PERCENTAGE OF SHOTS THAT HIT.

During the Spanish-American war it was estimated that only 3 per cent of the shots fired by American gunners hit the enemy's ships. In the recent quarterly target practice of the North Atlantic squadron, 51½ per cent of the shots hit.

HIGH WAGES.

The highest wage in the world, $78.30 a minute for a six hour day, is received by the Czar of Russia.

THE WORLD'S PRODUCTION OF PRECIOUS METALS

UNITED STATES LEADS.

Once more the United States leads in the production of precious metals. In the report of the director of the mint for the calendar year 1901, this country's output of gold and silver was $111,795,100, out of $368,373,800 turned out by the whole world. The figures of the world's ouput by countries were as follows:

	Gold	Silver, commercial value.
NORTH AMERICA.		
United States	$ 78,666,700	$ 33,128,400
Mexico	10,284,800	34,593,900
Canada	24,128,500	3,145,600
AFRICA AND AUSTRALASIA.		
Africa	$ 9,089,500	....
Australasia	76,880,200	$ 7,829,500
EUROPE.		
Russia	$ 22,850,900	$ 94,200
Austria-Hungary	2,136,700	1,198,000
Germany	59,800	3,313,000
Norway	....	99,500
Sweden	41,700	32,400
Italy	35,300	450,800
Spain	8,600	1,911,200
Portugal	1,300	2,300
Greece	....	692,300
Turkey	24,500	257,500
Finland	1,300	4,700
France	....	271,300
Great Britain	276,300	133,000
SOUTH AMERICA.		
Argentina	$ 30,000	$ 27,000
Bolivia	119,600	6,152,600
Chili	1,067,200	5,553,100
Colombia	2,801,300	1,129,000
Ecuador	110,000	4,600
Brazil	2,775,400	....
Venezuela	321,200	....
Guiana (British)	1,771,600	....
Guiana (Dutch)	405,600	....
Guiana (French)	2,000,000	....
Peru	1,329,200	3,360,500
Uruguay	31,700	500
CENTRAL AMERICA.		
Central America	$ 640,300	$ 527,800
ASIA.		
Japan	$ 1,201,600	$ 1,037,800
China	9,091,500	....
Corea	4,500,000	....
India (British)	9,395,900	....
East Indies (British)	861,700	....
East Indies (Dutch)	435,000	48,500
Totals	$263,374,700	$104,999,100

TOTAL NUMBER OF FINE OUNCES OF GOLD AND SILVER.

The total number of fine ounces of gold produced was 12,740,746, and of silver, 174,998, 573, the coinage value of the latter being $226,260,700.

GOLD AND SILVER EXPORTS AND IMPORTS OF PRINCIPAL COUNTRIES.

The imports and exports of the precious metals of the principal countries of the world during the calendar year 1901 are exhibited in the following table, the information relating to foreign countries having been received principally through representatives of the United States in those countries:

GOLD.

	Imports.	Exports.
United States	$ 54,761,880	$57,783,939
Africa	1,595,959	9,713,588
Austria-Hungary	35,731,855	7,585,753
Canada	4,574,809	24,744,890
Costa Rica	385,077	550,510
Denmark	804,000	....
Egypt	14,677,469	11,971,274
France	82,798,158	27,985,000
Federated Malay states	1,870,878	875,592
Germany	61,126,228	12,278,509
Great Britain	104,060,588	67,961,962
India (British)	26,952,409	20,666,059
Italy	914,994	2,607,640
Japan	5,308,563	5,720,562
Corea	1,290	2,450,737
Mexico	....	9,598,594
Netherlands	4,207,059	691,806
Nicaragua	....	435,000
Norway	516,386	....
Siam	2,361,450	79,700
Sweden	731,463	....
Switzerland	13,407,332	4,009,891
Russia	4,459,685	34,870,237
Portugal	1,322,387	1,355,909

The net sum of exports of Australian gold is estimated at $76,880,200, and of Chinese gold, at $9,091,500.

SILVER.

	Imports.	Exports.
United States	$ 31,146,782	$55,638,358
Africa	1,744,947	55,984
Argentina	23,995	86,959
Austria-Hungary	993,975	1,263,382
Bolivia	....	13,691,26
Canada	242,215	2,136,359
Costa Rica	....	47,943
Denmark	....	....
Dutch Guiana	52,560	28,097
Ecuador	....	....
Egypt	576,037	50,972
France	18,885,436	27,119,395
Federated Malay states	11,063,547	9,432,220
Germany	4,479,537	6,981,803
Great Britain	61,141,061	58,640,532
India	39,885,187	16,549,234
Italy	1,430,707	1,398,994
Japan	154,255	1,281,509
Corea	450,557	100,473
Mexico	2,279,875	50,269,606
Netherlands	3,278,008	889,557
Nicaragua	50,000	50,720
Norway	187,264	....
Peru	6,738	98,712
Siam	762,207	186,916
Sweden	83,062	....
Switzerland	8,429,956	2,278,442
Russia	4,818,854	1,905,930
China	4,334,047	148 310
Hong-Kong	7,623,616	3,747
Straits Settlements	13,787,004	167,333
East Africa	806,510	32,227
Arabia	617,226	226,805
Ceylon	2,011,280	1,154,470
Persia	393,217	236,705
Turkey	886,462	....
Australasia (net)	....	6,089,858

The industrial consumption of the precious metals in the world is estimated, in round numbers, at $80,000,000 gold and $57,000,000 silver.

INCREASE IN THE GOLD STOCKS OF VARIOUS COUNTRIES.

After allowing for industrial consumption, the increases in the gold stocks of the principal countries of the world for the calendar year 1901, are estimated to have been approximately as follows:

United States	$63,800,000
Austria-Hungary	27,600,000
Belgium	1,900,000
Great Britain	17,000,000
India	5,800,000
France	40 400,000
Germany	41,700,000
Italy	3,500,000
Japan	1,700,000
Netherlands	5,600,000
Portugal	2,300,000
Roumania	1,800,000
Sweden	1,800,000
Switzerland	3,500,000

ONLY COUNTRIES SHOWING LOSS.

The only countries showing a loss during the year are Norway, $1,600,000, and Russia, $9,700,000.

THE GLOBE'S GREATEST RIVERS

THE AMAZON.

A score of navigable rivers empty their volume into the Amazon, and many smaller streams are its tributaries. Its course is mainly through Brazilian territory. Its sources are the Tungurahua, flowing from the Peruvian Lake Laurichocha, and the Ucayalo, which originates in the Apurimac, 600 miles long, issuing from the Peruvian Andes. From the junction of the last-named stream, the Amazon runs nearly 1,800 miles to the Atlantic Ocean. Its actual length is 4,000 miles, and its estuary, gradually broadening as it approaches the sea, attains at the mouth a width of 180 miles. The basin of the Amazon includes about 2,000,000 square miles of soil.

THE MISSISSIPPI.

The Mississippi ranks next to the Amazon among the world's great streams. Rising in Lake Itasca, Minnesota, it runs southeasterly, with an extent, including its tributaries, of 4,400 miles. Together with these tributaries, the current of the Mississippi drains an area of about 1,100,000 square miles. It takes in the volume of the Missouri river near St. Louis, and meets the waters of the Ohio, where the states of Illinois, Kentucky and Ohio come into contact. Confluent with the Mississippi at their respective points of junction are the Illinois, Iowa, Wisconsin, White, Des Moines and St. Francis rivers. It is also joined by the Arkansas river south of its junction with the Ohio, and by the Red river as it approaches its outlet, in Louisiana.

The delta of the Mississippi, 120 miles south of the city of New Orleans, is composed mainly of three "passes," which afford entrance for ships of large tonnage from the Gulf of Mexico. These are called the Northeast Pass, the Southwest Pass and the Main Pass. Steamers of moderate draught ply the Mississippi for 2,000 miles above the delta.

THE YUKON.

The Yukon river has its source in British Columbia, and its outlet in Behring Sea. Its drainage basin includes a surface, approximately, of 200,000 square miles. The Yukon was formerly notable for fine fish, which it still produces, but its attractiveness in this regard was entirely overshadowed, in 1896, when the famous gold discoveries were made in a creek flowing into the great river. The width of the Yukon 600 miles from the ocean is about a mile. It is navigable for nearly its entire length of 2,000 miles.

THE NILE.

The river Nile is variously estimated at from 4,100 to 4,500 miles long. By most geographers its source has been supposed to be in Victoria Nyanza Lake. At Khartoum, the former capital of the Egyptian Su'dan, its two arms, the Blue Nile, issuing from Abyssinia, and the White Nile, flowing from the southwestern part of the continent, combine into a single stream, and constitute the main Nile, which courses its majestic way to the Mediterranean. Its delta is 120 miles wide between its west mouth at Rosetta and its east mouth at Damietta. The Rosetta mouth is 1,800 feet wide. The Nile is at flood from June to September, after which it subsides until January. Its mean rise at Cairo is 40 feet.

THE COLUMBIA.

The Columbia river, which flows into the Pacific ocean, has its source in the Rocky mountains. Its course is through Oregon, Washington and British Columbia. On account of natural obstructions, such as rapids, etc., less than one hundred miles of it is navigable. Although the bar at its mouth is liable to rough seas, the harbor is the safest on that coast for a distance of about 800 miles. The Columbia river is 1,400 miles long and affords an abundant supply of salmon of fine quality, on which is based one of the most important industries of the Pacific coast.

THE VOLGA.

The river Volga has its course in European Russia, and is the largest river in Europe. It finds its source in Seligher Lake, and carries its volume 2,500 miles into the Caspian Sea. Its estuary is divided into many passages, through some of which craft of considerable tonnage enter, and pass up the stream when flooded, as far as Tver. The basin of the Volga includes a superficial surface of nearly 400,000 square miles.

THE DANUBE.

Next to the Volga in extent and importance ranks the Danube, called the "Ister" in olden times. It has its source in the Schwarzwald, in Baden, is 2,000 miles long, and flows into the Black Sea through an estuary divided into a number of passages, of which the principal one is the Sulina. The course of the Danube is through the states of Württemberg, Bavaria, Austria, Hungary, Roumania and Bulgaria, and its main tributaries are the Leitha, Pruth, Theiss, Inn, Drave, Raab and Save. Steamboats ply the river as far as Pesth. England, Austria, France and Turkey guaranteed the free navigation of the Danube in 1856. During many centuries, this great river constituted the northeastern boundary of the Roman Empire.

THE GANGES.

The river Ganges is 1,900 miles long. Its source is in the Himalaya mountains, in India, whence it courses through a level and fertile country to its outlet in the Bay of Bengal. The delta of the Ganges reaches north of this bay for a distance of 200 miles, forming a hugh jungle. The Hugli, one of the branches of the Ganges, runs 200 miles, to Calcutta. For its main tributaries the Ganges has the Ramganga, 250 miles long; the Jumna, 680 miles long; and the Gumti, 480 miles long. Important cities line its banks, among them being Jessore, Dacca, Moorshedabad, Cawnpoor, Allahabad, and as before mentioned, Calcutta. This great and famous stream is regarded by the Hindoos as a sacred object.

THE MISSOURI.

The Missouri river is the main tributary of the Mississippi. Before its confluence with that stream, its chief fork, the Missouri proper, coursing northeasterly from its source in the Rocky Mountains a little more than 600 miles, and its minor fork, the Yellowstone, issuing from the same region and flowing northeasterly about 900 miles, join themselves together, and afterward pour their combined volumes into the "Father of Waters." The Missouri, proper, has for its main tributaries the Osage, Chariton, Grand, Platte and Kansas rivers, and is navigable for craft of medium size for more than 2,500 miles. The entire length of the Missouri river is 3,100 miles.

HOW TO DO BUSINESS

BOOK VII

. . . BY . . .

MORTON MacCORMAC, A. M.

President of the MacCormac School of Correspondence, Late Professor of Mathematics with the Bryant and Stratton Business College, Chicago

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EMBRACING

Self Instruction in Book-keeping
Short Methods of Computation
Points of Law and Legal Forms
Business and Social Correspondence
Spelling and Punctuation

SAFE BUSINESS RULES.

1. Never sign a paper without first reading it.

2. Shun lawsuits, and never take money risks because they look promising.

3. Never be afraid to say no. Every successful man must have the backbone to assert his rights.

4. Deal with strangers cautiously, not suspiciously.

5. Be frank and plain in all business affairs and put everything in writing.

6. Know your man before you become his security.

7. Keep strict account of every cent, and you will have more to keep account of.

8. Keep appointments promptly.

9. Don't promise more than you can do.

10. Small profits with little risk bring more than large profits on big risks.

11. Keep your business plans to yourself, yet be not afraid to "tell all."

12. Be honest, but not because it is the best policy.

13. If cleanliness is next to godliness, it is very close to success.

14. Watch details, but at all times consider yourself above them.

15. "Whatsoever thy hand finds to do, do it with all thy might."

16. Think success, talk success, and you are very likely to feel success.

17. The successful man is not he who does the most, but he who does *the best he can.*

18. "Rely upon your own strength of body and soul. Take for your star self-reliance, faith, honesty and industry. Don't take too much advice, keep at the helm and steer your own ship. Fire above the mark you intend to hit. Energy, determination, right motive are the levers that move the world".—*Noah Porter.*

19. If you would get justice be not too anxious about it.

20. Do not be ashamed of hard work. Work for the best salary or wages you can get, but work for anything rather than to be idle.

SELF-INSTRUCTION IN BOOKKEEPING.

RULES, DIRECTIONS, AND FORMS FOR KEEPING BOOKS.

THE SCIENCE OF ACCOUNTS.

BOOKKEEPING is a careful record of business transactions that has for its object the keeping of accounts in such a manner that we may at *any time* know the true condition of our business. Every person having occasion to keep accounts is greatly benefited by a knowledge of bookkeeping.

Methods.—There are two general methods for handling accounts now in use. The simpler method—practical only when the accounts are not numerous, or the business extensive—is Single Entry bookkeeping.

No. 1

The farmer is exchanging butter for soap with the grocer.

This is "barter"—an exchange of commodities—and represents a complete transaction.

Single Entry.

The books used are usually a Day-book, often called a blotter or memorandum book, a Cash-book and Ledger.

These books, of different sizes, may be found at the bookstores, though, in case of necessity, they can easily be made with a few sheets of foolscap paper, ruled as hereafter shown.

No. 2

Miss B. is selling Mr. D. an umbrella for cash. This is a complete transaction, being an exchange by both parties at the same time.

The method more in use, because of its flexibility or adaptability to all classes of accounts, is known as Double Entry. The books that can be employed in Double Entry are almost without number. In most common use, however, we find the Day-book, Journal (often these are combined), Cash-book and Ledger. To these are often added Invoice-book, Bill-book, Stock-book, individual

No. 3

Mr. R. is selling a piece of jewelry to Miss B. "on account"—that is, to be paid for at some future time.

This is not a completed transaction, the exchange being made by the first party, but not by the second party. Who is the debtor? Who is the creditor?

No. 4

Miss B. is now paying Mr. R. for the jewelry that she previously bought from him, which completes her part in the transaction and cancels her indebtedness to him. Mr. B. gives her a "receipt" for the money.

Ledgers, petty Cash-books, etc. It is now our purpose to take you through a series of transactions in which we will first use Single Entry; later we will change our books from Single to Double Entry and continue the transactions to a point where you can easily note the distinctive points of difference between Single and Double Entry.

In making charges in a book and giving credit, it is necessary to keep clearly in mind whether the person of whom we write *gives* or *receives*. If the individual *gives* he is a *creditor*, which is designated by the abbreviation Cr. If the person receives he is a *debtor*. It is designated by Dr.

We herewith submit a series of transactions which cover the ground of an ordinary set of books. Our efforts have been to make the statements clear and exclude everything not necessary. We illustrate the journal or day-book, ledger, and bill-book. To these could be added the cash-book, but we have preferred to run all cash through the journal.

No. 5

Mr. J. has sold some real estate to Mr. L. for which Mr. L. is giving his note due in 60 days—that is, he gives his promise in writing to pay the amount at the end of 60 days. Mr. J. has completed his part of the transaction, but Mr. L. has not. This is an exchange of land for a promissory note.

Invoice and other books are added for the purpose of clearing up the work of a large business, but in ordinary accounting are not needed.

NOTE.—The following transactions illustrate the books of J. R. Dunn, a farmer, who has a farm of 160 acres, and also owns an interest in the village store. He desires to, at all times, know the true condition of his business, whether he is making or losing money, and which interest pays him best. He may adopt either method—Double or Single Entry. Study carefully the following forms, and you will see that *on any day* he can determine his exact worth in dollars and cents. If every man could but realize how easy it is to keep his accounts in a correct manner much of the anxiety and annoyance in settling estates would be at an end. It might be well to remember that the wife as well as the husband can in this manner know conditions as they exist, and through coöperation with her husband will do much to add to the family's contentment and prosperity.

No. 6

The 60 days has expired. Mr. L. now gives his check for the amount of the note to Mr. J. This completes Mr. L.'s part in the transaction. Mr. J. is endorsing his name across the back of the note, which shows that he has received payment in full. He will hand the note back to Mr. L.

DAY-BOOK TRANSACTIONS—SINGLE ENTRY.

JANUARY 1, 1902.

J. R. Dunn invests				
Farm of 160 acres, valued at $60 per acre,				9600 00
Store and lot, valued at				3000 00
Stock of goods in store valued at				6840 00
Live stock worth				980 00
Machinery and implements worth				1040 00
James Adams owes on %				86 00
A. H. Ames " "				41 00
Cash on hand				1464 00
He owes the following debts				
Edward Drake on %				145 00
S. E. Howard "				76 00
	8			
Sold Jas. Mann on %				
1 bbl. flour		$4 95	4 95	
5 lbs. coffee		30¢	1 50	
2 lbs. tea		50¢	1 00	
5 bu. timothy seed		$1 95	9 75	17 20
	10			
Cash sales to date amount to				244 60
	10			
Paid for repairing wagons				14 00
	13			
Sold J. C. Evans on %				
20 bu. oats		40¢	8 00	
1 ton feed		$22 00	22 00	
1 bbl. flour		$5 10	5 10	35 10
	17			
Cash receipts for the week amount to				294 67
	19			
Bo't of E. B. Harvey on %				
28 bbls. flour		$4 10	114 80	
40 bu. timothy seed		$1 40	56 00	
10 " clover "		$3 80	38 00	
4 bbls. sugar, 1210 lbs.		5¼¢	63 53	
6 bags Rio coffee, 642 lbs.		21¢	134 82	407 15
	20			
Sold A. D. Rand				
One horse for				140 00
Received in payment, cash				40 00
His 30 day note for balance				100 00
	20			
Bo't of S. H. Hines on %				
6 bx. soap		$4 00	24 00	
6 doz. canned corn		98¢	5 88	
15 " " peaches		$1 20	18 00	
12 " " peas		80¢	9 60	57 48
	21			
Paid cash for horseshoeing				3 40
	24			
Cash receipts for the week amount to				246 24
	25			
Bo't for cash vegetables, eggs, etc., in bulk				4 60

JANUARY 26, 1902.

Sold A. W. Williams				
10 bars soap	6¢	60		
4 cans corn	12¢	48		
4 lbs. cheese	11¢	44		
2 tons feed	$22 00	44 00	45 52	
Took in part payment potatoes, eggs, etc., valued at			16 50	
31				
Paid J. Arnold for wages			24 00	
" E. H. Hayes for wages			19 00	
" Geo. Scott " "			35 00	
31				
Cash sales for the week			294 20	

FEBRUARY 2, 1902.

Paid sundry expense bills in cash			1 40
5			
Sold John Rogers on %			
14 lbs. pork	11¢	1 54	
2 " coffee	30¢	60	
6 " rice	10¢	60	2 74
7			
Cash sales for the week			264 10
12			
Paid county, town and school taxes in cash			46 80
13			
Sold Jas. Winkle on %			
1 mowing machine (secondhand)			24 00
14			
Cash sales for the week			248 40
17			
Bo't of E. J. Young one job lot of clothing, books and shoes			425 00
Gave him our 30 day note for same			425 00
19			
Received cash from A. D. Rand in payment of his note			100 00
21			
Cash sales for the week			314 20
21			
Paid current expense bills in cash			11 40
23			
Sold J. Harvey			
1 cow for			36 00
23			
Took his 60 day note in payment			36 00
25			
Paid S. E. Howard on % cash			26 00
27			
Received of James Adams on %			20 00
28			
Cash sales for the week			296 45

FEBRUARY 28, 1902.

		Paid Jno. Arnold for wages			24 00
		" E. H. Hayes " "			19 00
		" Geo. Scott " "			35 00

MARCH 4, 1902.

		Sold Jas. Franklin			
		1 bbl. sugar, 304 lbs.	6¢		18 24
		4			
		Received in payment			
		4 bbls. apples	$1 50	6 00	
		Cash for balance		12 24	18 24
		7			
		Gave Edw. Drake to settle account our note for one year for			145 00
		7			
		Cash sales for the week			321 20
		9			
		Received cash from A. H. Ames on %			26 00
		12			
		Received cash from James Adams on %			35 00
		14			
		Cash sales for the week			267 20
		17			
		Paid current expenses to date			14 25
		19			
		Paid E. J. Young our 30 day note in cash			425 00
		21			
		Cash sales for the week			290 14
		24			
		Sold J. E. Emery on %			
		1 suit working clothes	$6 50	6 50	
		2 pr. working gloves	$1 00	2 00	
		1 " shoes	$2 75	2 75	11 25
		27			
		Bo't of E. B. Harvey on %			
		14 bbls. flour	$3 90	54 60	
		90 bu. timothy seed	$1 50	135 00	
		25 " clover "	$3 90	97 50	287 10
		29			
		Cash sales for the week			284 19
		30			
		Sold J. C. Evans on %			
		4 bu. timothy seed	$1 90	7 60	
		2 " clover "	$4 75	9 50	17 10
		Paid Jno. Arnold for wages			24 00
		" E. H. Hayes " "			19 00
		" Geo. Scott " "			35 00

Now note carefully the arrangement of the transactions into journal form; this can be done from the start, thus obviating the use of a blotter or day-book. We have given them

here, however, that each successive step may be seen. Often it occurs that transactions must be jotted down and arranged systematically at a future time; hence, to get the form fixed in your mind is valuable.

SINGLE ENTRY DAY-BOOK.

JANUARY 1, 1902.

1	J. R. Dunn	Cr.		23051 00
	By 160 acres land	$60 00	9600 00	
	Store and lot		8000 00	
	Mdse. (on hand)		6840 00	
	Live stock		980 00	
	Machinery and implements		1040 00	
	Jas. Adams' account		86 00	
	A. H. Ames' account		41 00	
	Cash on hand		1464 00	
	1			
1	J. R. Dunn	Dr.		221 00
	To Edward Drake's account		145 00	
	" S. E. Howard's account		76 00	
	1			
1	Jas. Adams	Dr.		86 00
	To am't due on commencing			
	1			
1	A. H. Ames	Dr.		41 00
	To am't due on commencing			
	1			
2	Edward Drake	Cr.		145 00
	By am't due on commencing			
	1			
2	S. E. Howard	Cr.		76 00
	By am't due on commencing			
	3			
2	Jas. Mann	Dr.		17 20
	To 1 bbl. flour	$4 95	4 95	
	" 5 lbs. coffee	30¢	1 50	
	" 2 " tea	50¢	1 00	
	" 5 bu. timothy seed	$1 95	9 75	
	13			
3	J. C. Evans	Dr.		35 10
	To 20 bu. oats	40¢	8 00	
	" 1 ton feed	$22 00	22 00	
	" 1 bbl. flour	$5 10	5 10	
	19			
3	E. B. Harvey	Cr.		407 15
	By 28 bbls. flour	$4 10	114 80	
	" 40 bu. timothy seed	$1 40	56 00	
	" 10 " clover seed	$3 80	38 00	
	" 4 bbls. sugar, 1210 lbs.	5¼¢	63 53	
	" 6 bags Rio coffee, 642 lbs.	21¢	134 82	
	20			
3	A. D. Rand	Dr.		140 00
	To 1 horse			
	20			
3	A. D. Rand	Cr.		140 00
	By cash		40 00	
	" his 30 day note		100 00	

JANUARY 20, 1902.

4	S. H. Hines	Cr.		57 48
	By 6 bx. soap	$4 00	24 00	
	" 6 doz. canned corn	98¢	5 88	
	" 15 " " peaches	$1 20	18 00	
	" 12 " " peas	80¢	9 60	
	26			
4	A. W. Williams	Dr.		45 52
	To 10 bars soap	6¢	60	
	" 4 cans corn	12¢	48	
	" 4 lbs. cheese	11¢	44	
	" 2 tons feed	$22 00	44 00	
	26			
4	A. W. Williams	Cr.		16 50
	By potatoes, eggs, etc.			

FEBRUARY 5, 1902.

4	John Rogers	Dr.		2 74
	To 14 lbs. pork	11¢	1 54	
	" 2 " coffee	30¢	60	
	" 6 " rice	10¢	60	
	13			
5	Jas. Winkle	Dr.		24 00
	To 1 mowing machine (secondhand)			
	17			
5	E. J. Young	Cr.		425 00
	By 1 job lot clothing, boots and shoes			
	17			
5	E. J. Young	Dr.		425 00
	To our 30 day note			
	23			
5	J. Harvey	Dr.		36 00
	To 1 cow			
	23			
5	J. Harvey	Cr.		36 00
	By his 60 day note			
	25			
2	S. E. Howard	Dr.		26 00
	To cash			
	27			
1	James Adams	Cr.		20 00
	By cash			

MARCH 4, 1902.

6	Jas. Franklin	Dr.		18 24
	To 1 bbl. sugar, 304 lbs.	6¢		
	4			
6	Jas. Franklin	Cr.		18 24
	By 4 bbls. apples	$1 50	6 00	
	" cash		12 24	

MARCH 7, 1902.

	2	Edward Drake To our note for 1 year	Dr.	145 00	
		9			
	1	A. H. Ames By cash	Cr.	26 00	
		12			
	1	James Adams By cash	Cr.	35 00	
		24			
	6	J. E. Emery To 1 suit working clothes " 2 pr. " gloves " 1 " shoes	Dr. $6 50 $1 00 $2 75	11 25	 6 50 2 00 2 75
		27			
	3	E. B. Harvey By 14 bbls. flour " 90 bu. timothy seed " 25 " clover "	Cr. $3 90 $1 50 $3 90	287 10	 54 60 135 00 97 50
		30			
	3	J. C. Evans To 4 bu. timothy seed " 2 " clover "	Dr. $1 90 $4 75	17 10	 7 60 9 50

NOTE.—Our day book is now arranged; the next step is posting. We have opened accounts with each person with whom business is transacted. Now by referring to the journal you will see that the proprietor is credited with a total of $23,051. This amount is to be placed to his credit on the right-hand side of the account. He owes, or is debtor, for $221, for which he is charged on the debit side of the account.

The general laws for debit and credit, and the specific laws governing the different transactions will be given at the close of the set.

Mr. Dunn, the Farmer: "Bookkeeping has been a great help to me. I now know what I have actually made and lost this last year."

LEDGER.

Little explanation is here needed to those who nave carefully observed the form of the ledger. It is the book of accounts containing a condensed form of all the debits and credits, each item being placed under its proper head.

Notice that the accounts are placed on the left-hand side for debits, and on the right-hand side for credits. The difference between the sides of these accounts shows either a resource or liability, or gain or loss, depending, of course, upon whether the account is a fixed or fluctuating account, for example: the second account indicates that you are indebted to James Adams for $20 and $35, while Mr. Adams owes us $86; the difference, called a balance, is a resource in our favor.

The reverse condition is true with the fifth account, where Mr. Howard is shown by the ledger as giving us a total of $76, whereas we give him but $50. In the Adams account notice that we have brought down the balance of $31 to the debit side, indicating that he owes us that amount, whereas in the Howard account the balance is brought down to the credit side, showing that we owe him. You will notice that all balances are first written in red ink. This shows you that the account has been placed in this position for a temporary object, and when it is permanently placed it will be written in black.

Difference between Single and Double Entry Ledgers.

In the single entry ledger there are only personal accounts. When you reach the double entry you will find that we add such accounts as merchandise and expense. These accounts show us the gain or loss. For instance, with merchandise the debit side represents the value of the merchandise purchased; the credit side the value of the merchandise sold. Now if all merchandise is sold, the difference between the sides of the accounts will show the gain or loss—gain if the credit side is in excess of the debit; loss if the reverse condition is true. The steps for closing will be given you later, and if you are careful to observe them you should have no difficulty with the preceding simple transactions of business. **We are now ready to look at the cash-book.**

No. 7

Mr. M. has sold goods to Mr. P. on account at 30 days, for which he is giving him a bill. The transaction is not completed. Whose part is not completed? Who is the debtor?

No. 8

Mr. M. at the end of thirty days gives his note to Mr. R. in settlement of his account. Has Mr. M. cancelled his indebtedness? Is the transaction completed?

No. 9

This illustration shows Mr. M. paying his note. The note being returned to him by Mr. P., this completes the transaction.

SINGLE ENTRY LEDGER.

J. R. DUNN.

1902					1902				
Jan.	1		1	221 00	Jan.	1		1	23051 00
Mar.	*31*	*Present worth*		*23303 66*	Mar.	31	Net gain as per statement		473 66
				23524 66					23524 66
					Apr.	1	Present worth		23303 66

JAMES ADAMS.

1902					1902				
Jan.	1		1	86 00	Feb.	27		3	20 00
					Mar.	12		4	35 00
						31	*Balance*		*31 00*
				86 00					86 00
Apr.	1	Balance		31 00					

A. H. AMES.

1902					1902				
Jan.	1		1	41 00	Mar.	9		4	26 00
						31	*Balance*		*15 00*
				41 00					41 00
Apr.	1	Balance		15 00					

EDWARD DRAKE.

1902					1902				
Mar.	7		4	145 00	Jan.	1		1	145 00

S. E. HOWARD.

1902					1902				
Feb.	25		3	26 00	Jan.	1		1	76 00
Mar.	*31*	*Balance*		*50 00*					
				76 00					76 00
					Apr.	1	Balance		50 00

JAMES MANN.

1902					1902				
Jan.	3		1	17 20	*Mar.*	*31*	*Balance*		*17 20*
Apr.	1	Balance		17 20					

J. C. EVANS.

1902					1902				
Jan.	13		1	35 10	*Mar.*	*31*	*Balance*		*52 20*
Mar.	30		4	17 10					
				52 20					52 20
Apr.	1	Balance		52 20					

E. B. HARVEY.

1902					1902				
Mar.	*31*	*Balance*		*694 25*	Jan.	19		2	407 15
					Mar.	27		4	287 10
				694 25					694 25
					Apr.	1	Balance		694 25

A. D. RAND.

1902					1902				
Jan.	20		2	140 00	Jan.	20		2	140 00

S. H. HINES.

1902					1902				
Mar.	*31*	*Balance*		*57 48*	Jan.	20		2	57 48
					Apr.	1	Balance		57 48

A. W. WILLIAMS.

1902					1902				
Jan.	26		2	45 52	Jan.	26		2	16 50
					Mar.	31	Balance		29 02
				45 52					45 52
Apr.	1	Balance		29 02					

JOHN ROGERS.

1902					1902				
Feb.	5		3	2 74	Mar.	31	Balance		2 74
Apr.	1	Balance		2 74					

JAS. WINKLE.

1902					1902				
Feb.	13		3	24 00	Mar.	31	Balance		24 00
Apr.	1	Balance		24 00					

E. J. YOUNG.

1902					1902				
Feb.	17		3	425 00	Feb.	17		3	425 00

J. HARVEY.

1902					1902				
Feb.	23		3	36 00	Feb.	23		3	36 00

JAS. FRANKLIN.

1902					1902				
Mar.	4		4	18 24	Mar.	4		4	18 24

J. E. EMERY.

1902					1902				
Mar.	24		4	11 25	*Mar.*	*31*	*Balance*		*11 25*
Apr.	1	Balance		11 25					

SINGLE ENTRY CASH-BOOK.

1902			Rec'd	Paid Out
Jan.	3	Am't on hand	1464 00	
	10	Receipts for week	244 60	
	10	Paid for repairing wagon		14 00
	17	Receipts for week	294 67	
	20	Rec'd from A. D. Rand	40 00	
	21	Paid for horseshoeing		2 40
	24	Receipts for week	246 24	
	25	Paid for vegetables, eggs, etc.		4 60
	31	Paid J. Arnold for wages		24 00
	31	" E. H. Hayes for wages		19 00
	31	" Geo. Scott " "		35 00
	31	Receipts for week	294 20	
Feb.	2	Sundry expenses		1 40
	7	Receipts for week	264 10	
	12	Paid taxes		46 80
	14	Receipts for week	248 40	
	19	To A. D. Rand's note	100 00	
	21	Current expenses		11 40
	25	Paid S. E. Howard on %		26 00
	27	Rec'd from Jas. Adams on %	20 00	
	28	Receipts for week	296 45	
	28	Paid J. Arnold for wages		24 00
	28	" E. H. Hayes for wages		19 00
	28	" Geo. Scott " "		35 00
Mar.	4	Rec'd from Jas. Franklin on %	12 24	
	7	Receipts for week	321 20	
	9	A. H. Ames on %	26 00	
	12	James Adams "	35 00	
	14	Receipts for week	267 20	
	17	Current expenses		14 25
	19	Paid our note favor E. J. Young		425 00
	21	Receipts for week	290 14	
	29	" " "	284 19	
	31	Paid Jno. Arnold for wages		24 00
	31	" E. H. Hayes " "		19 00
	31	" Geo. Scott " "		35 00
			4748 63	779 85

BILLS RECEIVABLE.

No.	When Rec'd		Drawer or Endorser	Drawee or Maker	In Whose Favor	For What Received	Where Pay'ble	Note or Draft	Date of Paper			Time	When Due													Amount		Rate of Int.	When and How Disposed Of		
									Month		Year		Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.						
1	Jan.	20		A. D. Rand	J. R. Dunn	Part payment of horse		Note	Jan.	20	1902	30 days			19											100	00		Feb	19	Paid
2	Feb.	23		J. Harvey	"	Part pay-m't of cow		"	Feb.	23	1902	60 days					24									36	00				

BILLS PAYABLE.

No.	When Issued		Drawer or Endorser	Drawee or Maker	In Whose Favor	For What Given	Where Pay'ble	Note or Draft	Date of Paper			Time	When Due													Amount		Rate of Int.	When and How Disposed Of		
									Month		Year		Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.						
1	Feb.	17		J. R. Dunn	E. J. Young	Mdse.		Note	Feb.	17	1902	30 days				19										425	00		Mar.	19	Paid
2	Mar.	7		"	Edw. Drake	To settle %		"	Mar.	7	"	1 yr.				$^{7}_{03}$										145					

SINGLE ENTRY STATEMENT OF RESOURCES AND LIABILITIES.

RESOURCES.			
Cash per cash-book		4282 98	
Bills Rec. per bill-book		36 00	
Real est. (farm) per inventory		9600 00	
" " (store and lot) per inventory		3000 00	
Merchandise per inventory		5424 00	
Live stock " "		825 00	
Machinery " "		900 00	
Jas. Adams owes on %		31 00	
A. H. Ames " "		15 00	
Jas. Mann " "		17 20	
J. C. Evans " "		52 20	
A. W. Williams owes on %		29 02	
J. Rogers owes on %		2 74	
Jas. Winkle " "		24 00	
J. E. Emery " "		11 25	
	Total assets		24250 39
LIABILITIES.			
Bills Pay. per bill-book		145 00	
S. E. Howard owes him on %		50 00	
E. B. Harvey " " "		694 25	
S. H. Hines " " "		57 48	
	Total liabilities		946 73
J. R. Dunn's present worth			23303 66
" net investment			22830 00
" " gain			473 66

DOUBLE ENTRY JOURNAL.

We next take up the transactions in Double Entry form, and urge you to especially take note of the fact that not only are the debits and credits arranged in a convenient manner for posting, but an entire history of the transaction is recorded on the right hand of the page in a manner ready for convenient reference. The figures on the left indicate the page in the ledger to which the accounts are transferred.

JANUARY 1, 1902.

1	Real estate (farm), 160 acres land	$60 00	9600 00	
1	" " (store and lot)		3000 00	
2	Mdse., stock of goods in store		6840 00	
2	Live stock		980 00	
2	Machinery		1040 00	
3	James Adams owes him		86 00	
3	A. H. Ames " "		41 00	
3	Cash on hand		1464 00	
1	J. R. Dunn investment			23051 00
	1			
1	J. R. Dunn	Debts	221 00	
4	Edw. Drake on %			145 00
4	S. E. Howard on %			76 00

JANUARY 3, 1902.

4	Jas. Mann	Sold on %	17 20	
2	Mdse., 1 bbl. flour, $4 95	$4 95		17 20
	5 lbs. coffee, 30¢	$1 50		
	2 " tea, 50¢	$1 00		
	5 bu. timothy seed, $1 95	$9 75		
	10			
3	Cash	Sales for the week	244 60	
2	Mdse.			244 60
	10			
5	Expense	Paid for repairing wagons	14 00	
3	Cash			14 00
	13			
5	J. C. Evans	Sold on %	35 10	
2	Mdse., 20 bu. oats, 40¢	$8 00		35 10
	1 ton feed, $22 00	$22 00		
	1 bbl. flour, $5 10	$5 10		
	17			
3	Cash	Sales for the week	294 67	
2	Mdse.			294 67
	19			
2	Mdse.	Bo't on %	407 15	
5	E. B. Harvey, 28 bbls. flour, $4 10	$114 80		407 15
	40 bu. timothy seed, $1 40	$56 00		
	10 " clover " $3 80	$38 00		
	4 bbls. sugar, 1210 lbs., 5¼¢	$63 53		
	6 bags Rio coffee, 642 lbs., 21¢	$134 82		
	20			
3	Cash	Sold A. D. Rand 1 horse	40 00	
6	B. Rec.	Rec'd cash $40 00, his 30 da. note for balance	100 00	
2	Live stock			140 00
	20			
2	Mdse.	Bo't on %	57 48	
6	S. H. Hine, 6 bx. soap, $4 00	$24 00		57 48
	6 doz. canned corn, 98¢	$5 88		
	15 " " peaches, $1 20	$18 00		
	12 " " peas, 80¢	$9 60		
	21			
5	Expense	Paid for horseshoeing	2 40	
3	Cash			2 40
	24			
3	Cash	Sales for the week	246 24	
2	Mdse.			246 24
	25			
2	Mdse.	Bo't for cash	4 60	
3	Cash	vegetables, eggs, etc., in bulk		4 60
	26			
6	A. W. Williams	Sold on %	45 52	
2	Mdse., 10 bars soap, 6¢	60¢		45 52
	4 cans corn, 12¢	48¢		
	4 lbs. cheese, 11¢	44¢		
	2 tons feed, $22 00	$44 00		
	26			
2	Mdse.	Rec'd in part payment	16 50	
6	A. W. Williams, of above bill, potatoes, eggs, etc.			16 50

JANUARY 31, 1902.

5	Expense	Paid J. Arnold for wages $24 00	78 00	
3	Cash	" E. H. Hayes for wages $19 00		78 00
		" Geo. Scott " " $35 00		
		31		
3	Cash sales for the week		294 20	
2	Mdse.			294 20

FEBRUARY 2, 1902.

5	Expense	Paid sundry expenses	1 40	
3	Cash			1 40
		5		
7	John Rogers	Sold on %	2 74	
2	Mdse., 14 lbs. pork, 11¢	$1 54		2 74
	2 " coffee, 30¢	60¢		
	6 " rice, 10¢	60¢		
		7		
3	Cash sales for the week		264 10	
8	Mdse.			264 10
		12		
5	Expense	Paid county, town and school taxes	46 80	
3	Cash			46 80
		13		
7	Jas. Winkle	Sold on %	24 00	
1	Machinery (1 mowing machine, second-hand)			24 00
		14		
3	Cash	Sales for the week	248 40	
8	Mdse.			248 40
		17		
2	Mdse.	Bo't of E. J. Young on our 30 da.	425 00	
7	B. Pay.	note 1 job lot of clothing, books and shoes		425 00
		19		
3	Cash	Rec'd cash from A. D. Rand	100 00	
6	B. Rec.	in payment of his note		100 00
		21		
9	Cash	Sales for the week	314 20	
8	Mdse.			314 20
		21		
5	Expense	Paid current expenses	11 40	
3	Cash			11 40
		23		
6	B. Rec.	Sold J. Harvey 1 cow	36 00	
2	Live stock	Rec'd his 60 da. note in payment		36 00
		25		
4	S. E. Howard	Paid on %	26 00	
3	Cash			26 00
		27		
9	Cash	Rec'd on %	20 00	
3	James Adams			20 00
		28		
9	Cash sales for the week		296 45	
8	Mdse.			296 45
		28		
5	Expense	Paid J. Arnold for wages, $24 00	78 00	
3	Cash	" E. H. Hayes for wages, $19 00		78 00
		" Geo. Scott " " $35 00		

MARCH 4, 1902.

10	Jas. Franklin	Sold on %	18 24	
8	Mdse., 1 bbl. sugar, 304 lbs., 6¢	$18 24		18 24
	4			
2	Mdse. rec'd 4 bbls. apples, $1 50	$6 00	6 00	
9	Cash	Cash $12 24 in	12 24	
10	Jas. Franklin	payment of above bill		18 24
	7			
4	Edw. Drake	Gave him our note	145 00	
7	B. Pay.	for 1 year to settle %		145 00
	7			
9	Cash	Sales for the week	821 20	
8	Mdse.			821 20
	9			
9	Cash rec'd on %		26 00	
3	A. H. Ames			26 00
	12			
9	Cash	Rec'd on %	35 00	
3	Jas. Adams			35 00
	14			
9	Cash	Sales for the week	267 20	
8	Mdse.			267 20
	17			
5	Expense	Paid current expenses	14 25	
9	Cash			14 25
	19			
7	B. Pay.	Paid E. J. Young our	425 00	
9	Cash	30 da. note in cash		425 00
	21			
9	Cash sales for the week		290 14	
8	Mdse.			290 14
	24			
10	J. E Emery	Sold on %	11 25	
8	Mdse., 1 suit working clothes	$6 50		11 25
	2 pr. " gloves, $1 00	$2 00		
	1 " shoes	$2 75		
	27			
2	Mdse.	Bo't on %	287 10	
5	E. B. Harvey — 14 bbls. flour, $3 90	$54 60		287 10
	90 bu. timothy seed, $1 50	$135 00		
	25 " clover " $3 90	$97 50		
	29			
9	Cash sales for the week		284 19	
8	Mdse.			284 19
	30			
5	J. C. Evans	Sold on %	17 10	
8	Mdse., 4 bu. timothy seed, $1 90	$7 60		17 10
	2 " clover " $4 75	$9 50		
	31			
5	Expense	Paid J. Arnold for wages $24 00	78 00	
9	Cash	" E. H. Hayes for wages $19 00		78 00
		" Geo. Scott " " $35 00		

This is followed by the Double Entry Ledger, the form of which is the same as for the Single Entry, but which contains not only the personal accounts, but all other materials of importance with which we have dealt.

DOUBLE ENTRY LEDGER.

J. R. DUNN.

1902					1902				
Jan.	1		1	221 00	Jan.	1		1	23051 00
Mar.	*31*	*Present Worth*	✓	*23303 66*	Mar.	31	Loss and Gains	10	473 66
				23524 66					23524 66
					Apr.	1	Present Worth	✓	23303 66

REAL ESTATE (FARM).

1902					1902				
Jan.	1		1	9600 00	*Mar.*	*31*	*Inventory*	✓	*9600 00*
Apr.	1	Inventory	✓	9600 00					

REAL ESTATE (STORE AND LOT).

1902					1902				
Jan.	1		1	3000 00	*Mar.*	*31*	*Inventory*	✓	*3000 00*
Apr.	1	Inventory	✓	3000 00					

MERCHANDISE.

1902					1902				
Jan.	1		1	6840 00	Jan.	3		1	17 20
	19		2	407 15		10		1	244 60
	20		2	57 48		13		1	35 10
	25		2	4 60		17		1	294 67
	26		2	16 50		24		2	246 24
Feb.	17		4	425 00		26		2	45 52
Mar.	4		6	6 00		31		3	294 20
	27		7	287 10	Feb.	5		4	2 74
				8043 83		7		2	264 10
						14		4	248 40
						21		4	314 20
			2	8043 83		28		4	296 45
Mar.	*31*	*Loss and Gain*	*10*	*892 91*	Mar.	4		5	18 24
						7		6	321 20
						14		6	267 20
						21		6	290 14
						24		6	11 25
						29		6	284 19
						30		7	17 10
						31	*Inventory*	7	*5424 00*
								✓	8936 74
				8936 74					
Apr.	1	Inventory	✓	5424 00					

LIVE STOCK.

1902					1902				
Jan.	1		1	980 00	Jan.	20		2	140 00
Mar.	*31*	*Loss and Gain*	*10*	*21 00*	Feb.	23		4	36 00
					Mar.	*31*	*Inventory*	✓	*825 00*
				1001 00					1001 00
Apr.	1	Inventory	✓	825 00					

MACHINERY.

1902					1902				
Jan.	1		1	1040 00	Feb.	13		4	24 00
					Mar.	*31*	*Inventory*	✓	*900 00*
							Loss and Gain	10	*116 00*
				1040 00					1040 00
Apr.	1	Inventory	✓	900 00					

JAMES ADAMS.

1902					1902				
Jan.	1		1	86 00	Feb.	27		5	20 00
					Mar.	12		6	35 00
						31	*Balance*	✓	*31 00*
				86 00					86 00
Apr.	1	Balance	✓	31 00					

A. H. AMES.

1902					1902				
Jan.	1		1	41 00	Mar.	9		6	26 00
						31	*Balance*	✓	*15 00*
				41 00					41 00
Apr.	1	Balance	✓	15 00					

CASH.

1902					1902				
Jan.	1		1	1464 00	Jan.	10		1	14 00
	10		1	244 60		21		2	2 40
	17		1	294 60		25		2	4 60
	20		2	40 00		31		3	78 00
	24		2	246 24	Feb.	2		4	1 40
	31		3	294 20		12		4	46 80
Feb.	7		4	264 10		21		4	11 40
	14		4	248 40		25		5	26 00
	19		4	100 00		28		5	78 00
				3196 21					262 60

CASH.

1902					1902				
			3	3196 21				3	262 60
Feb.	21		4	314 20	Mar.	17		6	14 25
	27		5	20 00		19		6	425 00
	28		5	296 45		31		7	78 00
Mar.	4		6	12 24		*31*	*Balance*	✓	*4282 98*
	7		6	321 20					
	9		6	26 00					
	12		6	35 00					
	14		6	267 20					
	21		6	290 14					
	29		7	284 19					
				5062 83					5062 83
Apr.	1	Balance	✓	4282 98					

EDWARD DRAKE.

1902					1902				
Mar.	7		6	145 00	Jan.	1		1	145 00

S. E. HOWARD.

1902					1902				
Feb.	25	Balance	5	26 00	Jan.	1		1	76 00
Mar.	*31*	*Balance*	✓	*50 00*					
				76 00					76 00
					Apr.	1	Balance	✓	50 00

JAMES MANN.

1902					1902				
Jan.	3		1	17 20	*Mar.*	*31*	*Balance*	✓	*17 20*
Apr.	1	Balance	✓	17 20					

EXPENSE.

1902					1902				
Jan.	10		1	14 00	*Mar.*	*31*	*Loss and Gain*	*10*	*324 25*
	21		2	2 40					
	31		3	73 00					
Feb.	2		4	1 40					
	12		4	46 80					
	21		4	11 40					
	28		5	78 00					
Mar.	17		6	14 25					
	31		7	78 00					
				324 25					324 25

J. C. EVANS.

1902					1902				
Jan.	13		1	35 10	*Mar.*	*31*	*Balance*	✓	*52 20*
Mar.	30		7	17 10					
				52 20					52 20
Apr.	1	Balance	✓	52 20					

E. B. HARVEY.

1902					1902				
Mar.	*31*	*Balance*	✓	*694 25*	Jan.	19		2	407 15
					Mar.	27		7	287 10
				694 25					694 25
					Apr.	1	Balance	✓	694 25

BILLS RECEIVABLE.

1902					1902				
Jan.	20		2	100 00	Feb.	19		4	100 00
Feb.	23		4	36 00	*Mar.*	*31*	*Balance*	✓	*36 00*
				136 00					136 00
Apr.	1	Balance	✓	36 00					

S. H. HINE.

1902					1902				
Mar.	*31*	*Balance*	✓	*57 48*	Jan.	20		2	57 48
					Apr.	1	Balance	✓	57 48

A. W. WILLIAMS.

1902					1902				
Jan.	26		2	45 52	Jan.	26		2	16 50
					Mar.	*31*	*Balance*	✓	*29 02*
				45 52					45 52
Apr.	1	Balance	✓	29 02					

JOHN ROGERS.

1902					1902				
Feb.	5		4	2 74	*Mar.*	*31*	*Balance*	✓	*2 74*
Apr.	1	Balance	✓	2 74					

JAS. WINKLE.

1902					1902				
Feb.	13		4	24 00	*Mar.*	*31*	*Balance*	✓	*24 00*
Apr.	1	Balance	✓	24 00					

BILLS PAYABLE.

1902					1902				
Mar.	19		6	425 00	Feb.	17		4	425 00
	31	*Balance*	✓	*145 00*	Mar.	7		6	145 00
				570 00					570 00
					Apr.	1	Balance	✓	145 00

JAS. FRANKLIN.

1902					1902				
Mar.	4		6	18 24	Mar.	4		6	18 24

J. E. EMERY.

1902					1902				
Mar.	24		6	11 25	*Mar.*	*31*	*Balance*	✓	*11 25*
Apr.	1	Balance	✓	11 25					

LOSS AND GAIN.

1902					1902				
Mar.	31	Machinery	2	116 00	Mar	31	Mdse.	8	892 91
		Expense	5	324 25			Live stock	2	21 00
		J. R. Dunn	*1*	*473 66*					
				913 91					913 91

NOTE.—We have closed and balanced the accounts. Use red ink where rulings appear. Italics indicate red ink.

Having posted your accounts into the ledger and *before closing* the ledger, your next step is to take a trial balance. You have noticed throughout Double Entry Bookkeeping, that every debit has its corresponding credit, and every credit its corresponding debit. Now if you have properly debited and credited the items, your ledger will be in balance. The trial balance will tell this. The totals of all the debits and all the credits of each account are placed in the form below given.

TRIAL BALANCE.

1	J. R. Dunn	221 00	23051 00
1	Real Estate (Farm)	9600 00	
1	Real Estate (Store & Lot)	3000 00	
2	Mdse.	8043 83	3513 74
2	Live Stock	980 00	176 00
2	Machinery	1040 00	24 00
3	Jas. Adams	86 00	55 00
3	A. H. Ames	41 00	26 00
3	Cash	5062 83	779 85
4	Edw. Drake	145 00	145 00
4	S. E. Howard	26 00	76 00
4	James Mann	17 20	
5	Expense	324 25	
5	J. C. Evans	52 20	
5	E. B. Harvey		694 25
6	Bills Receivable	136 00	100 00
6	S. H. Hine		57 48
6	A. W. Williams	45 52	16 50
7	John Rogers	2 74	
7	Jas. Winkle	24 00	
7	Bills Payable	425 00	570 00
10	Jas. Franklin	18 24	18 24
10	J. E. Emery	11 25	
		29302 06	29302 06

A GOOD PROOF OF CORRECTNESS.

You will see by the above that the ledger is in balance. This is a very good proof of its correctness, but is by no means sufficient. Your ledger may be in balance and your accounts may be wrong, for you may have credited John Adams, whereas the debit should have gone

to merchandise. Likewise you may have credited the wrong account. The next step, therefore, before closing your ledger is to make a balance sheet. Here we have come to a grand finale, for after the balance sheet is completed all that remains to be done is but mechanical.

You will notice, first, that the balance sheet consists of the columns you have used for the trial balance, and in addition columns for loss and gain and for resources and liabilities. The loss and gains of a business come from two sources: first, from our speculative investments, live stock and other property; second, from the incidental receipts and expenditures necessary to carry on the business. The latter is shown you in the expense account.

In the remaining columns we find our resources have two sources: either the amount due us from others, or property on hand as inventories. Our liabilities represent the amount due others, and our outstanding notes. You will notice that the difference between the loss and gain accounts shows that we have gained $473.66. This amount, when added to the proprietor's account as a credit, shows that the difference gives him a present worth of $23,303.66. This you will note represents the difference between the resources and liabilities account, and causes these accounts to balance; and second, the separate amounts of gain and loss on each account; third, our net gains; fourth, the individual amounts owed us or on hand; and fifth, the individual amounts that we owe or are outstanding against us; and lastly, we have proven our present worth—first, by adding our gains to the proprietor's account, and second, having subtracted our liabilities from our resources, we now have a full and complete history of our business to date and are ready to close the ledger.

HOW TO CLOSE THE LEDGER.

1. Enter all inventories to the accounts to which they belong.
2. Proceed to close all fluctuating accounts into the loss and gain account.
3. Close the loss and gain account into the proprietor's account. The difference between the sides thereof will show his present worth or insolvency.
4. Next close all fixed accounts. These represent your resources and liabilities, and the difference between them, as shown by the balance sheet or resources and liabilities account in the ledger, if you care to open one, corresponds with the closing of the proprietor's account.
5. Bring down to the opposite side of the account all balances from the resources and liabilities accounts.

RULINGS.

The first red line drawn indicates an addition and extends across the columns in which there are figures. The double red line indicates a balance and stands as a guard, showing you that it is not necessary for you to consider anything in the account above these lines, as it has already been disposed of.

BALANCE SHEET.

MARCH 31, 1902.

Folio	Accounts	Trial Balance		Losses & Gains		Res. & Lia.	
1	J. R. Dunn	221 00	230 51				
1	Real Estate (Farm) Inv. $9600	9600 00				9600 00	
1	Real Estate (Store & Lot) " 3000	3000 00				3000 00	
2	Merchandise " 5424	8043 83	3512 74		892 91	5424 00	
2	Live Stock " 825	980 00	176 00		21 00	825 00	
2	Machinery " 900	1040 00	24 00	116 00		900 00	
3	Jas. Adams	86 00	55 00			31 00	
3	A. H. Ames	41 00	26 00			15 00	
3	Cash	5062 83	779 85			4282 98	
4	Edw. Drake	145 00	145 00				
4	S. E. Howard	26 00	76 00				50 0
4	Jas. Mann	17 20				17 20	
5	Expense	324 25		324 25			
5	J. C. Evans	52 20				52 20	
5	E. B. Harvey		694 25				694 2
6	Bills Receivable	136 00	100 00			36 00	
6	S. H. Hine		57 48				57 4
6	A. W. Williams	45 52	16 50			29 02	
7	John Rogers	2 74				2 74	
7	Jas. Winkle	24 00				24 00	
7	Bills Payable	425 00	570 00				145 0
10	Jas. Franklin	18 24	18 24				
10	J. E. Emery	11 25				11 25	
		29302 06	29302 06	440 25	913 91	24250 39	946 7
	J. R. Dunn's Net Gain			*473 66*			
				913 91	913 91		
	J. R. Dunn's Investment		23051 00				
	J. R. Dunn Owed		221 00				
	J. R. Dunn's Net Investment		22830 00				
	J. R. Dunn's Net Gain		473 66				
	J. R. Dunn's Present Worth						23303 6
						24250 39	24250 3

GENERAL AND SPECIAL LAWS OF DEBIT AND CREDIT.

General.

Debit who or what cost value, or what is received.

Credit who or what produces value, or what is given.

Special.

PROPRIETOR AND PARTNER.

Debit.

1. For what he owes at beginning of business (if to be paid from the business).
2. For all withdrawals of money or property.
3. For all his personal debts assumed by the business.
4. For his net loss as found in the loss and gain account

Credit.

1. For what he invests either at the beginning or subsequent investments.
2. For any debts of the business paid by him.
3. For his net gain, as found in the loss and gain account.

PERSONS.

Debit.

1. For the amount they owe at beginning of business.
2. For all property sold them on account.
3. For any money paid or loaned them.
4. For any goods returned to them for which they had received credit.
5. For all drafts drawn by them and paid or accepted by us.

Credit.

1. For the amount we owe them at beginning of business.
2. For all property bought from them.
3. For all money received from them on account.
4. For any goods they may return to us.
5. For notes given us on account.
6. For drafts drawn on them by us.

BILLS RECEIVABLE.

Debit.

1. For notes or time drafts invested.
2. For all notes or time drafts received.
3. For all notes or time drafts made payable to others, but transferred to us.

Credit.

1. For all notes or time papers when paid or returned to parties issuing.
2. For all notes or time papers we sell, have discounted, or transferred.
3. For all part payments made.

BILLS PAYABLE.

Debit.

1. For all notes or other time papers when redeemed by us or returned to us.
2. For any part payment that may be made on notes issued by us.

Credit.

1. For all notes and other time papers held by us at the beginning of business.
2. For all time papers or notes given by us in favor of others.

CASH.

Debit.

1. For all cash invested in business.
2. For all cash received from any source.

Credit.

1. For all cash paid out, loaned or lost.

MERCHANDISE.

Debit.

1. For the inventory of stock on hand at the beginning of business.
2. For all merchandise bought.
3. For any goods returned after being once sold.
4. For freight, drayage, etc., unless separate accounts are kept.
5. Often for discounts allowed from original bill.

Credit.

1. For all sold.
2. For goods returned by us.
3. For insurance received for damaged or lost goods.
4. For goods taken from stock for private use.

EXPENSE.

Debit.

1. For the cost of the use of anything required to carry on the business, such as r postage, stationery, office furniture, services of clerks, drayage, storage.

NOTE.—Many of the above items may be carried in separate accounts, and should be, if large; in a small business they can all be classified as expense.

Credit.

1. For anything sold or given that has been charged to expense and for the inventor furniture, books, etc.

INTEREST AND DISCOUNT.

Debit Interest and Discount.

1. For all interest accrued and owing us at the beginning of business.
2. For the use of money received by us on our notes or accounts.
3. For the use of money received by us when others prepay their notes in our favor.
4. For money received by us on notes and drafts we transfer to others before they due.

Credit Interest and Discount.

1. For all interest accrued and owing to others at time of beginning.
2. For the use of money given to others on their notes, accounts, etc.
3. For the use of money given to others on notes or drafts discounted by us.
4. For the use of money given to others when we prepay our own notes in their favor.
5. For the use of money given to others on their notes and drafts they transfer to us before they are due.

CONSIGNMENT ACCOUNTS.

Debit the Consignment.

1. For all charges paid, such as freight and drayage; also for boxing, repacking, advertising or other outlays necessary to effect a sale.
2. For all goods returned to us after being sold, and which have been credited to the consignment.
3. For the consignor's net proceeds remitted to him.

Credit the Consignment.

1. For all sales effected, for all rebates or overcharges on expense incident to sale, and when the charges are in excess of the total sales for an amount sufficient to close the account.

SHIPMENT ACCOUNT.

Debit the Shipment.

1. For the invoice value of goods when shipped.
2. For all charges incident to shipment.
3. For any drafts drawn on us or cash advanced on account of the shipment.

Credit the Shipment.

1. For all drafts drawn by us or cash received on account of shipment.
2. For all returns when the account sales have been received.

Miscellaneous Accounts.

In addition to the above might be mentioned numerous accounts that are often opened, such as freight and drayage account, merchandise and discount account, labor or service account, real estate, mortages, etc. All such accounts, however, show a loss or gain, and are directly under the old general law, that *we debit what costs and we credit what produces.*

COMMERCIAL ARITHMETIC

AND READY RECKONER.

ADDITION and multiplication are the two great essentials of commercial arithmetic. Authors for years have been troubling themselves to find some short process by which accuracy and rapidity can be reached in these branches. Little merit, however, have we been able to find in the many rules and methods devised to aid in these important branches. Rapid addition is important, but much more importance must be given to *accuracy*. Were we to pin the bookkeeper down to detail we would find that at least two-thirds of his time is spent in adding or multiplying, that he may get the accounts ready to enter into his several books. For many years we have had just one rule that we have found superior to all others. It is this: "Keep your lips closed and your pencil moving."

Watch a rapid figurer at his work and you will soon discover that the seat of mathematics is not located in the lower jaw.

HOW TO ADD RAPIDLY.

Logically it is easier to add than to read. We have in our alphabet twenty-six letters and fifty-four sounds, but in figuring we have but ten characters, each of which means the same thing at all times. Learn the figures as you have learned your letters. Study to combine them as you have studied to combine sounds and you will soon note a vast improvement in speed and correctness of work.

It is necessary, however, to acquire facility in grouping the figures into convenient sets. Start by grouping tens, but do not stop there. If seven and three make ten, it is just as sure that seven and eight make fifteen, or seven and six thirteen. Remember that whenever you see an 8, 5 and 2 together that you have 15, or if the combination be 5, 2, 7, 4 the addition is 18, not once, but always. The great reason for so many failures in addition, is due largely to the fact that the accountant is so anxious for the result that he does not stop to think what he is doing. *Think* always, think well, and you will soon be a rapid figurer. The

best accountants do not waste their time in learning to add two columns at one time, but instead add two or three figures at a time, and note the combination. The next time they are not obliged to add, for they *know* the combination when they see it. If you are introduced to a person two or three times it is safe to say that you know him. Apply the same power to your addition and you have learned to know at sight the figures with which you deal.

A simple process by which addition can be proven is here given, and is worthy of note. It was first published in one of Professor Eaton's valuable commercial texts, and is now considered standard.

$$\left.\begin{array}{r} 9876 = 30 = 3 \\ 8949 = 30 = 3 \\ 5678 = 26 = 8 \\ 9843 = 24 = 6 \\ 2698 = 25 = 7 \\ 3987 = 27 = 9 \\ 5425 = 16 = 7 \end{array}\right\} 43 = 7.$$

$$\overline{46456 = 25 = 7}$$

Adding you get the total here indicated. Next add across each set of figures, bringing out the total until it is reduced to one figure, and note that the total, when reduced, gives the same key number found through the totals of each set.

HOW TO MULTIPLY RAPIDLY.

Why did you cease to learn the multiplication table when you reached the twelves? There is no logical reason. If you will study the following table until you have reached the twenty-fives, you will find that it will be a source of great help to you on numerous occasions.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63	66	69	72	75
4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88	92	96	100
5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125
6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126	132	138	144	150
7	14	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147	154	161	168	175
8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	144	152	160	168	176	184	192	200
9	18	27	36	45	54	63	72	81	90	99	108	117	126	135	144	153	162	171	180	189	198	207	216	225
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250
11	22	33	44	55	66	77	88	99	110	121	132	143	154	165	176	187	198	209	220	231	242	253	264	275
12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	240	252	264	276	288	300
13	26	39	52	65	78	91	104	117	130	143	156	169	182	195	208	221	234	247	260	273	286	299	312	325
14	28	42	56	70	84	98	112	126	140	154	168	182	196	210	224	238	252	266	280	294	308	322	336	350
15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285	300	315	330	345	360	375
16	32	48	64	80	96	112	128	144	160	176	192	208	224	240	256	272	288	304	320	336	352	368	384	400
17	34	51	68	85	102	119	136	153	170	187	204	221	238	255	272	289	306	323	340	357	374	391	408	425
18	36	54	72	90	108	126	144	162	180	198	216	234	252	270	288	306	324	342	360	378	396	414	432	450
19	38	57	76	95	114	133	152	171	190	209	228	247	266	285	304	323	342	361	380	399	418	437	456	475
20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500
21	42	63	84	105	126	147	168	189	210	231	252	273	294	315	336	357	378	399	420	441	462	483	504	525
22	44	66	88	110	132	154	176	198	220	242	264	286	308	330	352	374	396	418	440	462	484	506	528	550
23	46	69	92	115	138	161	184	207	230	253	276	299	322	345	368	391	414	437	460	483	506	529	552	575
24	48	72	96	120	144	168	192	216	240	264	288	312	336	360	384	408	432	456	480	504	528	552	576	600
25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

RAPID MULTIPLICATION.

Multiply 63 by 11.

Add together $6 + 3 = 9$. Place the 9 between the 6 and 3 and you have **693, the con** amount.

To Multiply When the Tens Orders Are Alike, and the Units Add Ten.

Multiply 82 by 88.

$$\begin{array}{r} 8 \times 2 = \quad 16 \\ 8 \times 9 = 72 \\ \hline 7216 \end{array}$$

First multiply the units, next add 1 to the tens, figure in the multiplier **and multi** In other words, multiply each by itself, except to add 1 to the tens order.

To Multiply Any Two Numbers Together.

ILLUSTRATION.—

$$\begin{array}{r} 36 \\ 75 \\ \hline 2700 \end{array}$$

$5 \times 6 = 30$. Place 0, carry the 3.
$5 \times 3 = 15 + 3 = 18$. Carry the 18.
$7 \times 6 = 42 + 18 = 60$. Place 0, and carry the 6.
$7 \times 3 = 21 + 6 = 27$.

The rule is to proceed as in ordinary multiplication, except that you **carry the seco** multiplication over to the third.

To Multiply Mixed Numbers.

ILLUSTRATION.—$8\frac{1}{2} \times 4\frac{1}{2}$.

$$\begin{array}{r} 8\frac{1}{2} \\ 4\frac{1}{2} \\ \hline 32 \\ 6\frac{1}{4} \\ \hline 38\frac{1}{4} \end{array}$$

$8 \times 4 = 32$.
$8 + 4 = 12 \times \frac{1}{2} = 6$.
$\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$.

$9\frac{1}{4} \times 7\frac{1}{4}$.

$$\begin{array}{r} 9\frac{1}{4} \\ 7\frac{1}{4} \\ \hline 63 \\ 4 \\ \frac{1}{16} \\ \hline 67\frac{1}{16} \end{array}$$

$7 \times 9 = 63$.
$9 + 7 = 16 \times \frac{1}{4} = 4$.
$\frac{1}{4} \times \frac{1}{4} = \frac{1}{16}$.

$9\frac{1}{8} \times 9\frac{7}{8}$.

$$\begin{array}{r} 9\frac{1}{8} \\ 9\frac{7}{8} \\ \hline 90 \\ \frac{7}{64} \\ \hline 90\frac{7}{64} \end{array}$$

$9\frac{1}{8} + \frac{7}{8} = 10 \times 9 = 90$.
$\frac{1}{8} \times \frac{7}{8} = \frac{7}{64}$.

Many more illustrations might be given of what are termed "short cuts," as suggested in what we said relative to addition. However, we have little faith in the great multiplicity of rules and processes; we prefer to look at arithmetic from this standpoint: first, that in all arithmetic there are but two things to find, i.e., Larger numbers and Smaller ones; second, there are but four ways of finding them, i.e., Addition, Multiplication, Subtraction and Division.

We wish at this point to note some of the ways to know *when* to add, multiply, subtract or divide, for we take it that if you know *when* you will have little difficulty with the *how*.

First let us group together the figures 7, 6, 4, 3, 2, 5, 3, and your total is 30—you have found it by addition. Why? Well, perhaps because you could not find it any other way. 10, 10 and 10, again we have 30—either by adding or multiplying 10 by 3. In the first instance the numbers represent different sized units, in the second the units were of the same value. Hence it follows that we add *unlike* and multiply *like* numbers.

Again we wish to divide $30 between two men, one of the men to get $17. We subtract the latter from the total, getting a remainder of $13. We have subtracted for the same reason that we added; our numbers are *alike.* But if we wish to divide our money among three men, each to receive the *same*, division is our process for our units are *alike.* Hence we take it that with whole numbers we add or multiply to find the *totals;* we subtract or divide to find *parts.*

When we reach the subject of

HOW TO MULTIPLY AND DIVIDE FRACTIONS RAPIDLY.

we find a somewhat different condition, however—a condition that is responsible, we believe for the couplet:

> **Multiplication is my vexation,**
> **Division is twice as bad.**
> **The rule of three—it puzzles me,**
> **And Fractions make me mad.**

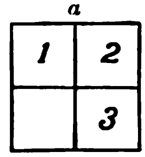
We have been taught all along that multiplication means increase, yet the reverse is true in more than seven-eighths of the examples with which we come in contact.

The Principles of Fractions.

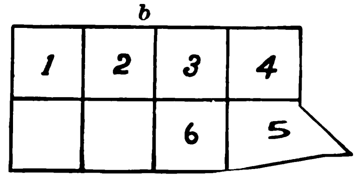
1. To multiply the numerator and denominator of a fraction by the same number does not change its value.

ILLUSTRATION.—

a

$\frac{3}{4}$, represented by a square, is 

b

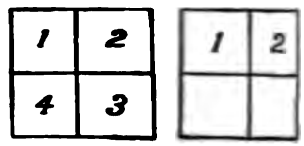


$\frac{3}{4} \times 2 = \frac{6}{8}$, represented by the same sized square, leaves exactly the same amount not disturbed.

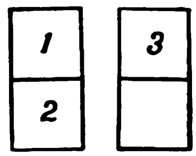
2. Multiplying the numerator or dividing the denominator of a fraction increases its value.

$\frac{3\times2}{4}=\frac{6}{4}$. One square will now be taken and part of another.

c d



The same sized square is divided into halves, and again one and one-half is gone.



$\frac{3}{4\times2}=\frac{3}{8}$.

3. Dividing the numerator or multiplying the denominator divides the fraction.

$\frac{3}{4}$ (for illustration) = $\frac{6}{8}$.

$$\frac{6}{8}\div2=\frac{3}{8}\text{ or }\frac{3}{4\times2}=\frac{3}{8}.$$

Now to their application. If you will note carefully you will see that **multiplication** means *decrease*, and division *increase*.

$$\begin{array}{r} 5\frac{3}{4} \\ 8 \\ \hline 40 \\ 6 \\ \hline 7)46 \\ \hline 6\frac{4}{7} \end{array} \qquad \frac{3}{4}\times8=6.$$

EXAMPLE.—At $\$\frac{7}{8}$ per yard, how many yards can be bought for $\$5\frac{3}{4}$? Now it is evident that at \$1 per yard we can buy $5\frac{3}{4}$ yards, and it is just as evident that at $\$\frac{7}{8}$ we can get *more* than $5\frac{3}{4}$ yards. As we can get more we want a larger number. Apply our principle of division for *larger* quantities, multiply by our denominator (which divides our fraction) and divide by our numerator (which also divides the fraction).

What is the cost of $\frac{8}{9}$ of a ton of iron if one ton costs $\$128\frac{4}{15}$?

REASON.—$\frac{8}{9}$ will cost less than a ton, hence a smaller quantity is desired. To get it we multiply first by the numerator, then divide by our denominator as follows:

$$\begin{array}{r} 128\frac{4}{15} \\ 8 \\ \hline 1024 \\ 2\frac{2}{15} \\ \hline 9)1026\frac{2}{15} \\ \hline 114\frac{2}{135} \end{array} \qquad \frac{2}{15\times9}=\frac{2}{135}.$$

DEDUCTION.—From the above illustrations form the following rule which applies to the greater part of arithmetic, for it must be remembered that percentage is fractional. (6% is .06—a fraction expressed decimally, or $\frac{6}{100}$, were it in the form of a common fraction.)

$$\text{Part}\begin{cases}\textbf{If required, multiply factors.}\\ \textbf{If given, divide factors.}\end{cases}$$

$$\begin{array}{r} 268\frac{13}{14} \\ 3\frac{5}{8} \\ \hline \frac{65}{112} \\ 167\frac{1}{2} \\ 804 \\ \hline 1\frac{97}{112} \\ 973 \\ \hline 974\frac{97}{112} \end{array} \qquad \left.\begin{array}{l} \frac{13}{14}\times\frac{5}{8}=\frac{65}{112} \\ \frac{5}{8}\times268=167\frac{1}{2} \\ \frac{13}{14}\times3=2\frac{11}{14} \\ 3\times268=804 \end{array}\right\}\text{Multiplication}$$

$$\begin{array}{r} 112 \quad \text{L. C. D.} \\ \hline \left.\begin{array}{r} 65 \\ 56 \\ 88 \end{array}\right\}\text{Addition} \\ \hline \end{array} \qquad \frac{209}{112}=1\frac{97}{112}$$

What has been said relative to addition and subtraction of whole numbers applies equally with fractions, whenever you add or subtract in fractions, but with multiplication or division the reverse condition is true. If the example has in both factors a mixed number the whole number law holds.

EXAMPLE.—If a ship sails $268\frac{13}{14}$ miles in one day, how far will she travel in $3\frac{5}{8}$ days?

Here, as in whole numbers, we multiply:

Study carefully the above illustration. Notice that to multiply we have not reduced to *Improper* fractions. This is rarely ever necessary.

BLIND MARK FOR MARKING GOODS.

In marking goods various devices are adopted to prevent the cost and selling price mark from becoming known to outsiders. The following is good:

b l a c k h o r s e
1 2 3 4 5 6 7 8 9 0

Instead of letters arbitrary characters may be used as follows:

Γ Δ Θ Ξ Π Φ ϝ Ω Ψ Σ Λ

For Marking All Goods Bought by the Dozen.

To make	20%	remove	the	point	one place to the left.				
"	"	80%	"	"	"	and add	$\frac{1}{2}$	itself.
"	"	60%	"	"	"	"	"	$\frac{1}{3}$	"
"	"	50%	"	"	"	"	"	$\frac{1}{4}$	"
"	"	44%	"	"	"	"	"	$\frac{1}{5}$	"
"	"	40%	"	"	"	"	"	$\frac{1}{6}$	"
"	"	37½%	"	"	"	"	"	$\frac{1}{7}$	"

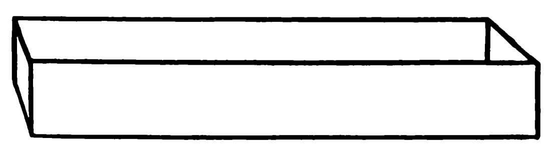
To make	35%	remove	the	point	and	add	$\frac{1}{8}$	itself.
"	33⅓%	"	"	"	"	"	$\frac{1}{9}$	"
"	32%	"	"	"	"	"	$\frac{1}{10}$	"
"	30%	"	"	"	"	"	$\frac{1}{12}$	"
"	28%	"	"	"	"	"	$\frac{1}{15}$	"
"	26%	"	"	"	"	"	$\frac{1}{20}$	"
"	25%	"	"	"	"	"	$\frac{1}{24}$	"
"	12½%	"	"	"	subtract		$\frac{1}{16}$	"
"	16⅔%	"	"	"	"		$\frac{1}{36}$	"
"	18¾%	"	"	"	"		$\frac{1}{96}$	"

FARMER'S SHORT RULES IN ARITHMETIC.

How to Measure Hay in the Mow or Stack.

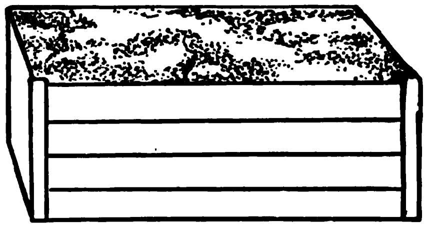
RULE.—Multiply the length in feet by the height in feet, and this by the breadth in feet, and divide the result by 500, and you have the number of tons in a mow; or, multiply the length in feet by the width in feet, and this by one-half the height, and divide the product by 300, and you have the number of tons in a stack.

How to Find the Contents of a Wagon Box.



A common wagon box is a little more than 10 feet long and 3 feet wide, and will hold about 2 bushels for every inch in depth.

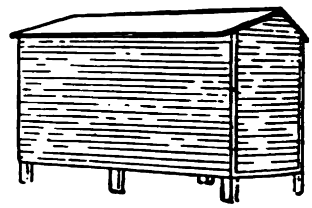
RULE.—Multiply the depth of a wagon box in inches by 2, to give the number of bushels, or if the wagon box is 11 feet long multiply the depth in inches by 2 and add one-tenth of the number of bushels to itself.



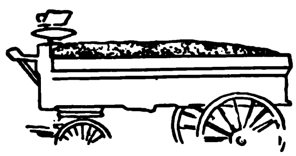
How to Find the Number of Bushels of Grain in a Bin or Box.

RULE.—Multiply the length in feet by the height in feet, and then again by the breadth in feet, and then again by 8, and cut off the right-hand figure. The result will be the number of bushels.

How to Measure Ear Corn in the Crib.



RULE.—Multiply the length in feet by the height in feet and that again by the width in feet, multiply the result by 4; cut off the right-hand figure and you have the contents in bushels of shelled corn.



How to Figure a Load of Grain.

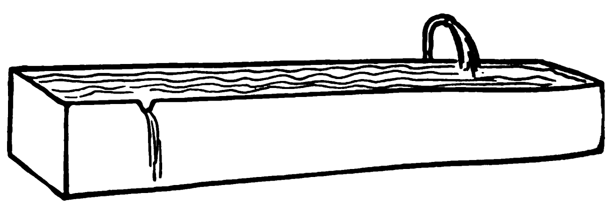
RULE.—Find the total number of pounds and divide that by the number of pounds in one bushel, and it will equal the number of bushels.

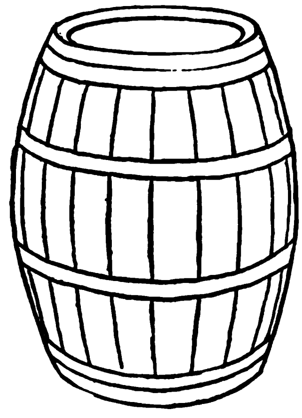
Number of Pounds to the Bushel, Approximate Weight.

Millet	50 pounds.	Wheat	60 pounds
Anthracite Coal	80 "	Corn on Cob	70 "
Clover Seed	60 "	Rye	56 "
Blue Grass Seed	14 "	Oats	32 "
Timothy Seed	45 "	Barley	48 "
Flax Seed	56 "	Buckwheat	50 "
Dried Peaches	33 "	Shelled Corn	54 "
Dried Apples	26 "	Corn Meal	50 "
Peas	60 "	Potatoes	60 "
Beans	60 "	Sweet Potatoes	55 "
Turnips	55 "	Onions	54 "

How to Find the Contents of a Watering Trough.

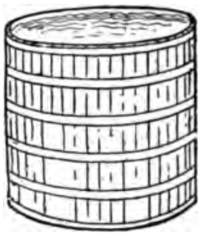
RULE.—Multiply the length in feet by the height in feet, and the product by the width in feet, and divide the result by 4, and the result will be the contents in barrels of $31\frac{1}{2}$ gallons each.





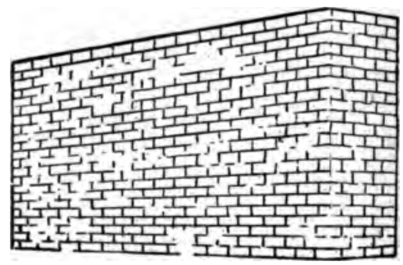
How to Find the Contents of Barrels and Casks.

RULE.—Add the diameters of the head and bung in inches and divide the sum by 2, and this will equal the average diameter. Then multiply the square of the average diameter by the length in inches and multiply this result by 34, and cut off the four right-hand figures. This is the number of gallons.



How to Find the Contents of a Round Tank.

RULE.—Multiply the square of the diameter in feet by the depth in feet, and multiply this result by 6, and the result is the approximate contents of the tank in gallons.



How to Find the Number of Common Bricks in a Wall or Building.

RULE.—Multiply the length of the wall in feet by the height in feet, and by its thickness in feet, and then multiply that result by 20, and that will give the number of bricks in the wall.

MISCELLANEOUS FACTS AND TABLES.

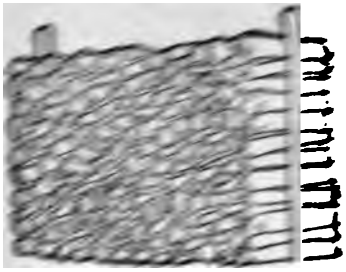
Avoirdupois Weight.—Used in weighing all bulky articles, grain, groceries, etc.

437½	grains	= 1 oz.
16	oz.	= 1 lb.
25	lbs.	= 1 qr.
2000	"	= 1 ton
2240	"	= 1 long ton
196	lbs. flour	= 1 bbl.
200	" beef or pork	= 1 "
280	" N. Y. salt	= 1 "
100	" nails	= 1 keg

Troy Weight.—

24	grains	= 1 pennyweight
20	pennyweights	= 1 ounce
12	ounces	= 1 pound
480	grains	= 1 ounce

Note that the avoirdupois pound contains 7000 grains, while the troy pound contains but 5760. If a dishonest grocer sells you a pound of tea by troy weight he cheats you, but if he sells you an ounce by troy weight he cheats himself out of 42½ grains.



Dry Measure.—

2 pints = 1 quart
8 quarts = 1 peck
4 pecks = 1 bushel

Cubic Measure.—

1728 cu. inches = 1 cu. foot
27 " feet = 1 " yard
2150.42 " inches = 1 bushel
231 " " = 1 gallon

ALIQUOT PARTS

One of the first tables to learn in arithmetic should be a table of aliquot parts of a dollar. You will find that the majority of prices are aliquots. So with any scale of fractions. You can easily apply, through your knowledge of aliquots, the following illustrations. Percentage work in all its phases gives much opportunity to use the following table. It is also very essential in billing and quick multiplication.

Cents.		
[illegible]	[illegible]	of one dollar
[illegible]	[illegible]	" " "
[illegible]	[illegible]	" " "
[illegible]	[illegible]	" " "
[illegible]	[illegible]	" " "
[illegible]	[illegible]	" " "
[illegible]	[illegible]	" " "
[illegible]	[illegible]	" " "
[illegible]	[illegible]	" " "
[illegible]	[illegible]	" " "
[illegible]	[illegible]	" " "
[illegible]	[illegible]	" " "
[illegible]	[illegible]	" " "
33⅓	[illegible]	" " "
37½	[illegible]	" " "
40	[illegible]	" " "
50	[illegible]	" " "
60	[illegible]	" " "
62½	⅝	" " "
66⅔	⅔	" " "
75	¾	" " "
83⅓	⅚	" " "
87½	⅞	" " "

Illustration.—Find the total value of the following: 720 yds. at 16⅔ cents. By referring to the table you will see that 16⅔ cents = ⅙ of a dollar, hence, at 16⅔ cents per yd. you can buy 6 yds. for one dollar. At a dollar per yd. 720 yds. would cost $720, but at ⅙ of a dollar it would be ⅙ of $720, or $120

Find total cost of

320 yds.	at	25	cents	equals	$\frac{1}{4}$ 320 ÷ 4 =	\$ 80.00
645 "	"	$87\frac{1}{2}$	"	"	$\frac{7}{8}$ 645 ÷ $\frac{7}{8}$ =	564.38
324 "	"	$33\frac{1}{3}$	"	"	$\frac{1}{3}$ 324 + $\frac{1}{3}$ =	108.00
						\$752.38

Easy Methods for Figuring Interest.

1. Any number of dollars when multiplied by any number of days will, when three figures are pointed off, produce the interest at 36%.

ILLUSTRATION.—

Principal,	\$3600
Time in days,	63
	10800
	21600
	\$226.800, Int. at 36%.

6% = $\frac{1}{6}$ of 36%,
hence, \$226.80 ÷ 6 = \$36.13$\frac{1}{3}$ Int. at 6%.
3% is $\frac{1}{12}$ of 36%.

Therefore, if 3% is wanted divide by 12. So with all multiples of 36. Dividing by 9 we have the interest at 4%, or if divided by 4.5 we have it for 8%, and so on through numerous combinations. It is, perhaps, better for the beginner to proceed as above until he has found the interest at 6%, then divide by 6 the second time, when the amount at 1 per cent is found. Having the interest at 1 per cent it is a very easy matter to find the amount for any other rate by multiplying by the required rate. One of the methods now in general use is called the bankers' method. The rule to remember in its workings is: Express all figures on one side of a perpendicular line, then put 360 on the opposite side and cancel.

ILLUSTRATION.—Find the interest on \$840 for 46 days at 6%.

	14
	$\cancel{840}$
$\cancel{360}$	46
	$\cancel{6}$

You have left 14 and 46, multiply them. 14 by 46 = \$6.44.
Presume the time is expressed in months, the process would be as follows:
Find the interest on \$965 for 9 mo. at 8%

$\cancel{3}$	965
$\cancel{12}$	$\cancel{9}$ 3
	$\cancel{8}$ 2

965 multiplied by 3 is \$28.95 × 2 = \$57.90.

One of the best and a method used perhaps oftener than any other is known as the 6% method. It is based on the following facts:

$1 at 6% for 1 year brings	$.06
$1 at 6% for 6 months brings	$.03
$1 at 6% for 1 month brings	$.005
$1 at 6% for 1 day brings	$.000⅙

Find the interest on $340 for 1 year, 5 months and 24 days at 6%:

For one year	$.06
For five months	.025
For 24 days	.004
	$.089,

$.089, total interest on $1 for the given time; hence, for $340, it is 340 times $.089 or $30.56. If you desire to find any other rate, divide by 6 and multiply by the rate desired.

yr.	mo.	da
1905	1	24
1897	10	16
7	3	8

To Find Time between Dates.

ILLUSTRATION.—Find the time from September 16, 1897, to January 24, 1905.

The legal and maximum rates of interest allowed by law in the different States and Territories of the United States are as follows:

TABLE OF INTEREST RATES.

States and Territories	Rate per Annum: Legal	Rate per Annum: Maximum	States and Territories	Rate per Annum: Legal	Rate per Annum: Maximum
Alabama	8%	8%	Montana	10%	10%
Alaska	......	.....	Nebraska	7%	10%
Arizona	7%	any %	Nevada	7%	any %
Arkansas	6%	10%	New Hampshire	6%	6%
California	7%	any %	New Jersey	6%	6%
Colorado	8%	any %	New Mexico	6%	12%
Connecticut	6%	any %	New York	6%	6%
Delaware	6%	6%	North Carolina	6%	6%
District of Columbia	6%	10%	North Dakota	7%	12%
Florida	8%	10%	Ohio	6%	8%
Georgia	7%	8%	Oklahoma	7%	any %
Idaho	7%	10%	Oregon	8%	10%
Illinois	5%	7%	Pennsylvania	6%	6%
Indiana	6%	8%	Rhode Island	6%	any %
Indian Ter	6%	any %	South Carolina	7%	8%
Iowa	6%	8%	South Dakota	7%	12%
Kansas	6%	10%	Tennessee	6%	6%
Kentucky	6%	6%	Texas	8%	10%
Louisiana	5%	8%	Utah	6%	8%
Maine	6%	any %	Vermont	6%	6%
Maryland	6%	6%	Virginia	6%	6%
Massachusetts	6%	any %	Washington	7%	12%
Michigan	6%	8%	West Virginia	6%	6%
Minnesota	7%	10%	Wisconsin	7%	10%
Mississippi	6%	10%	Wyoming	8%	12%
Missouri	6%	8%			

REMARK.—The legal rate of interest for England and France is 5%, and for the Dominion of Canada 6%.

The labor of computing compound interest may be abridged by the use of the following

Compound Interest Table.

Showing the amount of $1 at compound interest for any number of years from 1 year to 55 years inclusive:

Yrs.	1 per ct.	1½ per ct.	2 per ct.	2½ per ct.	3 per ct.	3½ per ct.	4 per ct.	Yrs.
1	1.0100 000	1.0150 000	1.0200 0000	1.0250 0000	1.0300 0000	1.0350 0000	1.0400 0000	1
2	1.0201 000	1.0302 250	1.0404 0000	1.0506 2000	1.0609 0000	1.0712 2500	1.0816 0000	2
3	1.0303 010	1.0456 784	1.0612 0800	1.0768 9062	1.0927 2700	1.1087 1787	1.1248 6400	3
4	1.0406 040	1.0613 636	1.0824 3216	1.1038 1289	1.1255 0881	1.1475 2300	1.1698 5856	4
5	1.0510 101	1.0772 840	1.1040 8080	1.1314 0821	1.1592 7407	1.1876 8631	1.2166 5290	5
6	1.0615 202	1.0934 433	1.1261 6242	1.1596 9342	1.1940 5230	1.2292 5533	1.2653 1902	6
7	1.0721 354	1.1098 450	1.1486 8567	1.1886 8575	1.2298 7387	1.2722 7926	1.3159 3178	7
8	1.0828 567	1.1264 926	1.1716 5938	1.2184 0290	1.2667 7008	1.3168 0904	1.3685 6905	8
9	1.0936 853	1.1433 900	1.1950 9257	1.2488 6297	1.3047 7318	1.3628 9735	1.4233 1181	9
10	1.1046 221	1.1605 408	1.2189 9442	1.2800 8454	1.3439 1638	1.4105 9876	1.4802 4428	10
11	1.1156 683	1.1779 489	1.2433 7431	1.3120 8666	1.3842 3387	1.4599 6972	1.5394 5406	11
12	1.1268 250	1.1956 182	1.2682 4179	1.3448 8882	1.4257 6089	1.5110 6866	1.6010 3222	12
13	1.1380 933	1.2135 524	1.2936 0663	1.3785 1104	1.4685 3371	1.5639 5606	1.6650 7351	13
14	1.1494 742	1.2317 557	1.3194 7876	1.4129 7382	1.5125 8972	1.6186 9452	1.7316 7645	14
15	1.1609 690	1.2502 321	1.3458 6834	1.4482 9817	1.5579 6742	1.6753 4883	1.8009 4351	15
16	1.1725 786	1.2689 855	1.3727 8570	1.4845 0562	1.6047 0644	1.7339 8601	1.8729 8125	16
17	1.1843 044	1.2880 203	1.4002 4142	1.5216 1826	1.6528 4763	1.7946 7555	1.9479 0050	17
18	1.1961 475	1.3073 406	1.4282 4625	1.5596 5872	1.7024 3306	1.8574 8920	2.0258 1652	18
19	1.2081 090	1.3269 507	1.4568 1117	1.5986 5019	1.7535 0605	1.9225 0132	2.1068 4918	19
20	1.2201 900	1.3468 550	1.4859 4740	1.6386 1644	1.8061 1123	1.9897 8886	2.1911 2314	20
21	1.2323 919	1.3670 578	1.5156 6634	1.6795 8185	1.8602 9457	2.0594 3147	2.2787 6807	21
22	1.2447 159	1.3875 637	1.5459 7967	1.7215 7140	1.9161 0341	2.1315 1158	2.3699 1879	22
23	1.2571 630	1.4083 772	1.5768 9926	1.7646 1068	1.9735 8651	2.2061 1448	2.4647 1555	23
24	1.2697 346	1.4295 028	1.6084 3725	1.8087 2595	2.0327 9411	2.2833 2849	2.5633 0417	24
25	1.2824 320	1.4509 454	1.6406 0599	1.8539 4410	2.0937 7793	2.3632 4498	2.6658 3633	25
26	1.2952 563	1.4727 095	1.6734 1811	1.9002 9270	2.1565 9127	2.4459 5856	2.7724 6979	26
27	1.3082 089	1.4948 002	1.7068 8648	1.9478 0002	2.2212 8901	2.5315 6711	2.8833 6858	27
28	1.3212 910	1.5172 222	1.7410 2421	1.9964 9502	2.2879 2768	2.6201 7196	2.9987 0332	28
29	1.3345 039	1.5399 805	1.7758 4469	2.0464 0739	2.3565 6551	2.7118 7798	3.1186 5145	29
30	1.3478 490	1.5630 802	1.8113 6158	2.0975 6758	2.4272 6247	2.8067 9370	3.2433 9751	30
31	1.3613 274	1.5865 264	1.8475 8882	2.1500 0677	2.5000 8035	2.9050 3148	3.3731 3341	31
32	1.3749 407	1.6103 243	1.8845 4059	2.2037 5694	2.5750 8276	3.0067 0759	3.5080 5875	32
33	1.3886 901	1.6344 792	1.9222 3140	2.2588 5086	2.6523 3524	3.1119 4235	3.6483 8110	33
34	1.4025 770	1.6589 964	1.9606 7603	2.3153 2213	2.7319 0530	3.2208 6033	3.7900 1634	34
35	1.4166 028	1.6838 813	1.9998 8955	2.3732 0519	2.8138 6245	3.3335 9045	3.9460 8899	35
36	1.4307 688	1.7091 395	2.0398 8734	2.4325 3532	2.8982 7833	3.4502 6611	4.1039 3255	36
37	1.4450 765	1.7347 766	2.0806 8509	2.4933 4870	2.9852 2668	3.5710 2543	4.2680 8986	37
38	1.4595 272	1.7607 983	2.1222 9879	2.5556 8242	3.0747 8348	3.6960 1132	4.4388 1345	38
39	1.4741 225	1.7872 103	2.1647 4477	2.6195 7448	3.1670 2698	3.8253 7171	4.6163 6599	39
40	1.4888 637	1.8140 184	2.2080 3966	2.6850 6384	3.2620 3779	3.9592 5972	4.8010 2063	40
41	1.5037 524	1.8412 287	2.2522 0046	2.7521 9043	3.3598 9893	4.0978 3381	4.9930 6145	41
42	1.5187 899	1.8688 471	2.2972 4447	2.8209 9520	3.4606 9589	4.2412 5799	5.1927 8391	42
43	1.5339 778	1.8968 798	2.3431 8936	2.8915 2008	3.5645 1677	4.3897 0202	5.4004 9527	43
44	1.5493 176	1.9253 330	2.3900 5314	2.9638 0808	3.6714 5227	4.5433 4160	5.6165 1508	44
45	1.5648 107	1.9542 130	2.4378 5421	3.0379 0328	3.7815 9584	4.7023 5855	5.8411 7568	45
46	1.5804 589	1.9835 262	2.4866 1129	3.1138 5086	3.8950 4372	4.8669 4110	6.0748 2271	46
47	1.5962 634	2.0132 791	2.5363 4351	3.1916 9713	4.0118 9503	5.0372 8404	6.3178 1562	47
48	1.6122 261	2.0434 783	2.5870 7039	3.2714 8956	4.1322 5188	5.2135 8898	6.5705 2524	48
49	1.6283 483	2.0741 305	2.6388 1179	3.3532 7680	4.2562 1944	5.3960 6459	6.8333 4937	49
50	1.6446 318	2.1052 424	2.6915 8803	3.4371 0872	4.3839 0602	5.5849 2686	7.1066 8335	50
51	1.6610 781	2.1368 211	2.7454 1979	3.5230 3644	4.5154 2320	5.7803 9930	7.3909 5068	51
52	1.6776 889	2.1688 734	2.8003 2819	3.6111 1235	4.6508 8590	5.9827 1327	7.6865 8871	52
53	1.6944 658	2.2014 065	2.8563 3475	3.7013 9016	4.7904 1247	6.1921 0824	7.9940 5226	53
54	1.7114 105	2.2344 276	2.9134 6144	3.7939 2491	4.9341 2485	6.4088 3202	8.3138 1435	54
55	1.7285 246	2.2679 439	2.9717 3067	3.8887 7303	5.0821 4859	6.6331 4114	8.6463 6692	55

NOTE 1.—To find the amount to which any given principal, at compound interest, will increas any rate per annum, and for any number of years given in the preceding tables:

Multiply the given principal by the amount of $1 of principal for the given time and rate annum, as shown in the table.

NOTE 2.—To find the compound interest which any given principal will produce at any rate annum, and for any number of years given in the preceding tables:

Subtract $1 from the amount of $1 for the given time and rate per annum, as shown in the ta the result will be the compound interest of $1 of principal. Multiply the compound interest of $ principal by the given principal.

For all examples of interest where 365 days are considered a year, use any of the methods h given and to your answer add $\frac{1}{73}$.

DISCOUNT.

All wholesale firms doing business by catalogue have a series of discounts upon th wares. These discounts are made for many reasons, chief of which is, perhaps, that the ad tional discount can be made to lower the price, or a certain rate per cent can be omitted increase the price without a change in the root price of the goods. A number of metho for figuring discounts are used. One of the simplest is illustrated in the following: pres the list price to be $630, with discounts of 20, 10, and 5%. 630 = 100%. Point off o place, or $63, and you have the rate at 10%; for 20% it would be twice this quantity, or $12 Subtract this from $630 and you have $50.40, subtract and you have $435.60. The next is 5% From $463.60 point off one place, you have $46.36—one-half of which would be 5 per cent, $23.18. Now subtracting we have $439.42. Again by the same process we have first $43.9 then $21.97. Subtracting we find the net amount of the bill to be $407.45.

SIMPLE PARTNERSHIP.

EXAMPLE.—J. P. Perrie and H. H. Pfeiffer engage in partnership—Perrie investin $9000 and Pfeiffer $7000. The firm's resources at closing consisted of cash $7095, re estate $7220, amount due by J. D. Gwynn $1680, merchandise $1340. The firm owes W. I Gibbons $1249, and S. Blandford $585. What was the net loss of the firm?

$9000 + $7000 = $16,000, net capital at beginning.

($7095 + $7220 + $1680 + $1340) – ($1249 + $585) = $15,501, net capital at end of year.

$16,000 – $15,501 = $499, net loss.

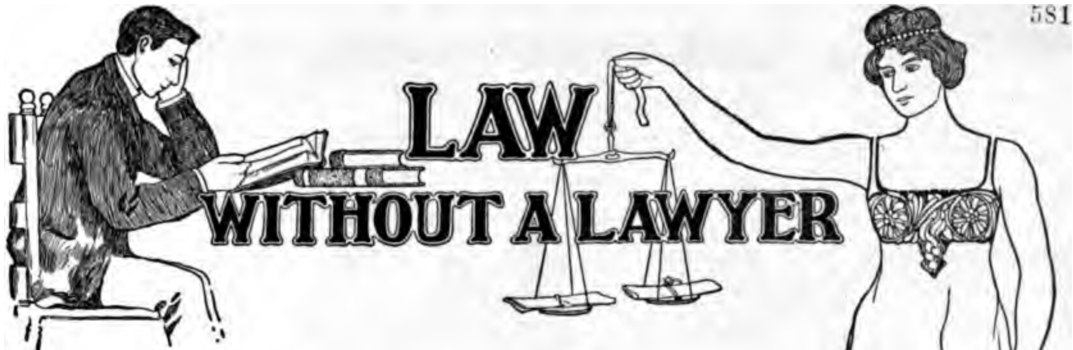
The above illustrates a very common form of partnership arrangement, and the cond tions surrounding it. Unless the agreement is otherwise the net loss or gain is shared equall We will next take an instance in which the division is made according to the investment:

EXAMPLE.—A and B engage in business, A investing $8500 and B $6000. The net pro is $2500. What was each partner's share?

$8500 + $6000 = $14,500, total capital.

	5		5
	~~$2500~~		~~$2500~~
~~$14500~~	$8500	~~$14500~~	$6000
29		29	

($5 × 8500) ÷ 29 = $1465.52 +, A's profit.
($5 × 6000) ÷ 29 = $1034.48 +, B's profit.



EVERY MAN HIS OWN LAWYER.

GLAD we are that the time has come when it is not *essential* for the student to "go away from home" to obtain a thorough knowledge of law, for good schools are coming to your door to give you, in your own home, a thorough education in any of the practical branches. The purpose of these chapters is not so far-reaching.

We desire only to present many of the standard facts and to them urge your attention.

In all matters of law let your common sense guide. Do not issue a valuable paper without first consulting a good attorney, unless you are *sure* you are right. If you have that knowledge, then save the fee. At least learn enough about law to keep out of its meshes.

> **If you are fond of pure vexation,**
> **And sweet procrastination,**
> **You are just in the situation**
> **To enjoy a suit at law.**

HOW TO SETTLE DIFFICULTIES WITHOUT GOING TO LAW.

Arbitration.

Any cause of trouble which is not criminal may be the subject of arbitration. The best way to settle difficulties between two parties is for each to appoint one disinterested person, and then the two thus selected appoint a third party, the three to consider the statements of the intending parties and their witnesses, if any. After hearing both sides of the case they can then decide upon the terms of settlement or award.

Conditions.

A court of equity will not, of course, compel any man to carry out an agreement to submit the difficulty to arbitrators; but when the difficulty has, by mutual consent of both parties in controversy, been once submitted for settlement, the decision of the arbitrators will be held as good and binding, unless there is some mistake or fraud entering into the decision.

Compulsory Performance.

If either of the parties, after the terms of settlement have been made known by the arbitrators, refuses to perform his part, he can, by the law, be made to carry out the conditions of the settlement or pay damages for non-performance; and the suit, if brought into court, must be on the non-performance, and not on the original claim. The original claim cannot be tried.

Arbitration is considered the most just way of settling matters under dispute of any known method. The work at The Hague, Holland, is proving most satisfactory for the governments of all enlightened nations who are there represented.

AFTER THE LAW SUIT.

The lawyer takes the cow, and leaves the contestants to fight it out among themselves.

The recent great coal strike, so jeopardizing to business and comfort, as all will remember, was settled in a most satisfactory manner by arbitration. If you cannot agree, instead of going into the court, settle by arbitration.

BUSINESS LAW.

Law is defined as a rule of action prescribed by proper authorities for our guidance. Its most common branches are International law, Municipal law, Common law, Statutory law, Commercial law. It is with the two latter branches that we have most to do, and propose to herein set forth some of the essentials that will be valuable, not only from the standpoint of general information, but will help the careful observer to avoid error and save difficulties that would otherwise arise. It is surprisingly unfortunate that so little is known by the majority of well-read citizens relative to the common things of law.

Agreements and Contracts.

A contract is an *agreement* between *competent* persons, based upon a *legal consideration* to do or not to do some act, not prohibited or enjoined by law. Note first that it must be an

agreement; an agreement consists of an *offer* and an *acceptance.* There are several ways in which this may come about, either by words or by action on the part of either party.

Example.—A builds a fence around your lot. You did not instruct him to do so, but with your knowledge he proceeds. The fact that you do not object, but instead acquiesce, is proof that you expect to pay for it, and A can collect an equitable amount; therefore, the building of the fence is the offer; your permission is the acceptance.

THE RESULT OF A DISAGREEMENT.

Silence does not give consent. If you were not aware that the fence was being built A could not recover damages. There must, in every case, be an acceptance. An offer once refused cannot be accepted without the consent of him who first made the offer. A offers to sell you a horse for $200. You say "No," and a little later say "Yes." You cannot compel A to deliver the horse. Acceptance makes a contract, and it is, therefore, important to know just when and how an acceptance can be made. A writes you that he will buy your farm at $50 per acre. The offer is presumed to be made when you *receive* the letter, and accepted when you mail your reply. The letter may be lost in the mail, but you are still bound by the contract. If A changes his mind and writes you that he will not pay you the price named, the contract still holds if you have accepted same before receiving the second letter.

Who May Make Contracts.

The general rule as to who may make contracts is: All persons of sound mind and legal age. There are a number of persons not competent to contract: First, infants (persons under 21); second, married women; third, lunatics.

Infants.—Contracts for the necessities of life, contracts for the maintenance of family and contracts for the burying of members of the family are binding when made by one not of legal age. It is quite often difficult to determine just what are the necessities of life. A, aged nineteen, goes to the jewelry store and buys a diamond pin. The father refuses to pay for it. It was proven, however, that all other members of the family had like jewelry, that they considered it a necessity, as the people with whom they associated, or desired to associate, wore diamonds. The judge ruled against the father. The law, however, defines quite clearly what the necessities are: board, clothing, instruction and medical aid.

Money is not a necessity, and if a minor borrows money, even though he uses it to buy a suit of clothes—that is a necessity—the parent is not required by law to return the money.

Married Women.—The law looks upon husband and wife as one, and by common law she could make no contracts unless (1) her husband was civilly dead—that is undergoing penal servitude, (2) an alien living in a foreign country, (3) divorced from her, (4) insane. Most States have, however, removed many of these disabilities to contract.

Lunatics.—A contract of a lunatic is voidable at the option of the insane person. Everybody is presumed to be of sound mind unless adjudged insane by the proper authorities.

Duress.—Any contract obtained by duress (force) is void. Personal restraint, fear of injury, imprisonment, are conditions that make a contract void. Undue influence of a strong mind over a weaker one is duress, and is sufficient cause for declaring a contract void.

A Vital Part of a Contract—Consideration.

There are two kinds of consideration—good and valuable. A good consideration is one based on love or esteem, as between immediate parties; it is sufficient to bind the agreement. If A, because of the esteem in which he holds you, gives you $1000, he cannot afterwards recover from you the money. The contract is *executed* and cannot be annulled. If, however, he agrees, because of his love for you, to give you $1000 and later changes his mind, you have no means of recovery. The contract has not been executed. It is said to be *executory*, and all such contracts must have a valuable consideration.

A Valuable Consideration.—The proof of a valuable consideration lies in the fact as to whether or not the one to whom promise is made does something or promises to do something because of the offer made. Money paid is always a valuable consideration. No matter how much or how little labor or time is devoted to the completion of an object, in fact anything that in any way would be considered of value or importancea, ccording to the great law of common sense, is a consideration, although it may not in any way be adequate to the amount of value received. Great tracts of land are every day being disposed of on the consideration of one dollar, and yet no one for a moment questions the validity.

A promise to do a thing impossible to be done cannot be enforced, but the impossibility must be natural or physical. The fact that the task is a difficult one is not a lawful excuse for non-performance.

Law Governing the Legality of Contracts.

Contracts Must Be Legal.—A contract between two parties in which the discussion rests on the turn of a card, or some other device in which one must be the loser and the other the winner, cannot be enforced by law. In all gaming, wagering or betting on futures, unless the contract is a bonafide one to buy or sell, the law will not sustain the contract. Contracts made on Sunday are valid unless especially prohibited by the statute of your State. The old common law granted the privilege of contracting on Sunday, and such contracts are good. No contract made for the purpose of fraud, contrary to the interests of public service, morality, safety, or contracts on the restraint of marriage or trade, can be enforced.

Fraudulent Contracts—Damages.

Fraud is a false representation of facts made with knowledge of the deception; and contracts of fraud cannot be enforced. It must be noticed, however, that the one who makes the representations must know of the falsehood or fraudulency underlying the proposition. If A offers his horse for sale, and B buys the horse, believing him to be sound in every particular, he cannot hold A if later he discovers an ailment that A was not aware of at the time of the sale. If, however, A has concealed an ailment he is held for fraud. If fraud has been practiced the one who has been deceived has two methods of redress: First, he may affirm the contract and later sue for damages because of the fraud practiced; or second, he may avoid the contract and not allow it to become binding upon him.

Various Kinds of Contracts—Giving Security, etc.

We find that many contracts must be recorded in a court of record. Some must be under seal, such as mortgages, deeds, etc. Some contracts *must be in writing*. Among this class are contracts for the transfer of lands or any permanent property, agreements to perform the contract within one year, for all sales of fifty dollars or over. In the latter case the buyer must receive at least a part of the goods, must pay a part of the price and give something to "bind the bargain."

Contracts of Guaranty for others, under any condition, must be in writing. I may step into a store with you and say to the proprietor, "If he does not pay for the goods I will see that you are paid." You are, of course, *morally* bound to see that the storekeeper does not suffer, but *legally* you are not bound.

All contracts in consideration of marriage, and the promise of executor or administrator to pay debts of decedent must be in writing.

Many forms must be in writing, but the safer plan is to put *all* in writing. A verbal agreement, especially before witnesses, is usually sufficient, for there are more men that are honest than dishonest, but safety is the "better part of valor."

Corporations.

When three or more individuals obtain from government the authority to act as one through their officers, with perpetual succession of members, and under a name selected for them and granted by the State, they become a corporation, with the right to transact the business for which the company was organized, in the same manner as an individual.

The advantages of incorporation are these: It combines capital and enterprise, with a limited pecuniary responsibility, which is generally a sum equal to the par value of the stock.

Pay Your Bills by Checks.

Keep your accounts in writing, and moreover pay your accounts by checks. If possible keep at least a small deposit in your bank and pay your bills with checks. You then not only have a complete record on the stub of the check-book, but when the voucher is returned have the very best form of receipt.

DO YOU HEAR—NEVER SIGN A PAPER WITHOUT CAREFULLY READING AND EXAMINING THE SAME.

HOW TO WRITE NOTES, DRAFTS, CHECKS, RECEIPTS, ETC.

So much of the world's volume of business is carried on through the medium of notes, drafts, checks, receipts, invoices, and other forms of business papers, that we should each be familiar with at least their correct form. We will not attempt to enter into a discussion of legal forms and the parties thereto, but will lay before you models of the latest approved forms.

Copy of the Famous Swindling Note.

Although the following scheme of the confidence man has been exposed time and time again, it still continues to add yearly to its list of victims. A paper is drawn up wherein a farmer agrees to pay ten or twenty dollars when he has sold goods to a given amount. By tearing off the right-hand end of this paper, what is apparently an agreement for a small amount, becomes a promissory note for a considerable sum. This note is sold to bank, thereby becoming the property of a third and innocent party, and the signer of the agreement is called upon to pay the note.

Battle Creek, Mich., July 10, 1896.

One year after date I promise to pay John Smith or bearer Ten Dollars, when I sell by order Four Hundred and Seventy-five Dollars' ($475) worth of Patent Fanning Mills, for Value Received, at Ten per cent, per annum...... Said Ten Dollars, when due, is payable at Battle Creek, Mich.

James A. Adams, Agent for John Smith.

Witness: G. Stevens.

PROMISSORY NOTES.

The two principal parties to a note are the Maker and the Payee—the Maker, he who signs; the Payee, the one in whose favor it is drawn.

There are a number of different forms of notes such as demand notes, joint notes, etc.; these will be brought out by a careful reading of the following.

Three days' grace is allowed on all time notes. Notes falling due Sunday, or on a legal holiday, must be paid the day previous. Notes dated Sunday are void. Notes given by minors are void.

THE SWINDLER SECURING THE SIGNATURE OF THE FARMER.

No. 1. Form of Note.

300\frac{00}{100}$ — Chicago, Ill., *November 17*, 190*4*

Thirty days....................after date *I* promise to

pay to the order of *John R. Smith*..............................300\frac{00}{100}$

Three Hundred..Dollars

at *First National Bank*

for value received.

Due ____________ *P. R. Wilson.*

No. 2. Form of Note.

720\frac{00}{100}$ — Omaha, Neb., *October 30*, 190*4*

Four months......................after date *we* promise to

pay to *Wilson Bros*..*or* order

Seven Hundred and Twenty..Dollars

at *our office, 100 Washington Street.*

Value received.

L. P. Wilson.

Due *February 28, 1905* *Chas. R. Thompson.*

No. 3. Form of Note.

188\frac{16}{100}$ — St. Louis, Mo., *November 18*, 190*4*

Sixty days......................after date, *we*

promise to pay to the order of *John Smith & Co.*,

One Hundred and Eighty-eight $\frac{16}{100}$..........................Dollars 188\frac{16}{100}$

for value received, with interest, at 6 per cent, after maturity.

Payable at *Commercial National Bank.*

No.________ Due_______ *R. M. Smith.*

Chas. R. Wilson.

Judgment Note.

$600.00/100 Chicago, Ill., *November 20*, 1905

Sixty days after date. promise to

pay to the order of *Chas. L. Walker*

Six Hundred Dollars

at *First National Bank* with interest

at *7* per cent per annum after *Maturity* until paid.

And to secure the payment of said amount, *I* hereby authorize, irrevocably, any attorney of any Court of record to appear for *me* in such Court, in term time or vacation, at any time hereafter, and confess a judgment without process in favor of the holder of this Note, for such amount as may appear to remain unpaid thereon, together with the costs and *25* dollars, attorney's fees, and to waive and release all errors which may intervene in any such proceedings, and consent to immediate execution upon such judgment, hereby ratifying and confirming all that *the* said attorney may do by virtue hereof.

No.______ Due______ *L. P. Wilson.*

DRAFTS AND CHECKS.

Drafts and checks are very similar in their form. The former are either orders of one person upon another to pay the first or a third person a sum of money, or they are the bank drafts used so extensively in commerce which are orders from one bank upon another bank in which they have money deposited, to pay the person named in the draft the face thereof. This form of draft differs from a check only in the particular that the former is between banks, whereas the latter is between an individual depositor and a local bank.

Sight Draft.

No. *87* Cincinnati, O., *June 21*, 1904

At sight, pay to the order of *J. T. Davis & Co*

Two Hundred Sixteen Dollars $216.00/100

Value received and charge to account of

To *J. R. Manning & Co.,* The Johnson Lumber Co

Des Moines, Iowa. per *Henry James.*

Acceptance.

Bush, Bright & Co. Chicago, Ill., *September 24,* 190*5*

Thirty days after sight................pay to

the order of *G. F. Raymond* $*211$\frac{21}{100}$*

Two Hundred Eleven $\frac{21}{100}$.................................... Dollars.

Value received and charge to account of

To *G. F. Raymond,* Bush, Bright & Co.

Denver, Colo. per *S. G. Kendall, Mgr.*

Time Draft.

The Richardson Hardware Co. No. *58*

Springfield, Ill., *June 29,* 190*3*

Sixty days after date..................pay to the order of

D. H. Turpin & Co...$*439$\frac{00}{100}$*

Four Hundred Thirty-nine..Dollars.

Value received and charge same to account of

To *D. H. Turpin & Co.* *The Richardson Hardware Co.*

St. Louis, Mo. *W. F. Richardson, Pres.*

Draft for Collection.

Wright, Bruce & Co. Buffalo, N. Y., *May 16,* 190*4*. No. *703*

At one day's sight........................pay to the

order of State National Bank $*93$\frac{00}{100}$*

Ninety-three.. Dollars.

Value received and charge the same to account of

To *W. H. Wilson & Co.,* ***Wright, Bruce & Co.***

Madison, Wis. ***W.***

Bank Draft.

FIRST NATIONAL BANK

Chicago, *January 3,* 1905

Pay *James Monroe*..or order

Six Hundred..Dollars

and charge to our account.

To *Metropolitan National Bank,* *G. W. Willis,*

New York City, N. Y. Cashier.

Form of Checks. No. 1.

Chicago, Ill., *November 1,* 1904. No. *6*

THE CITY NATIONAL BANK

OF CHICAGO

Pay to the order of *W. C. Billings*..$743 $\frac{00}{100}$

Seven Hundred Forty-three..Dollars.

Andrew Carlson.

No. 2.

Chicago, Ill., *November 28,* 1902 No. *169*

CHICAGO SAVINGS BANK
State & Washington Sts.

Pay to the order of *John Smith*..$50 $\frac{00}{100}$

Fifty..Dollars.

Morton MacCormac.

No. 3.

Cleveland, O., *June 15,* 190*3* No. *1325*

CLEVELAND NATIONAL BANK

Pay to the order of *J. W. Anderson & Co*........................ $\$6380\frac{00}{100}$

Sixty-three Hundred Eighty..Dollars.

H. W. Brown.

No. 4. Cashier's Check.

No. *6644* Kansas City, Mo., *August 17,* 190*3*

THE FIRST NATIONAL BANK

OF KANSAS CITY, MO.

Pay to the order of *James Jackson & Co*..................................

One Thousand Six Hundred..Dollars.

O. J. Johnson,

Cashier.

$\$1600\frac{00}{100}$

ENDORSEMENTS.

An Endorsement is anything written on the back of an instrument which relates to it. It is generally made for two purposes: first, to transfer a title; second, to add security for payment. There are five different kinds of endorsements in common use: Blank Endorsement, Full Endorsement, Qualified Endorsement, Conditional Endorsement and Restrictive Endorsement.

A Blank Endorsement

Has the effect of making the paper payable to the bearer. Anyone holding a paper endorsed in blank is presumed in law to be the holder thereof. If he desired to transfer the note he could do so by simply passing it on to another, or by making a special endorsement thereon. The form of the Blank Endorsement is:

L. M. Henderson.

The Full Endorsement

Is one which mentions the name of the Endorsee, with a direction to pay it. The draft or note is still negotiable, and may be passed on by any of the other forms of endorsement, after the provisions of the first have been complied with. Illustration of Full Endorsement:

Pay to T. E. Burns
or order.
L. M. Henderson.

We next show the Full and Blank Endorsements that you may note the difference between them:

L. M. Henderson
Pay to C. L. Weston
or order.
T. E. Burns.

Qualified Endorsement.

This is an endorsement which remits the liability of the Endorser. Presume that the Payee in transferring a note uses a qualified endorsement. He passes his interest in the note on to the Endorsee, but incurs no liability thereby. Illustration:

Pay to T. E. Burns
or order,
without recourse.
L. M. Henderson.

A Conditional Endorsement

Is one that transfers to the Endorsee, subject to the fulfilment of the conditions stated thereon; if the condition is not complied with the title in the paper reflects to the Endorsee, to whom the paper belongs.

Pay to T. E. Burns
or order, upon my
election to the Presidency
of the B. & O. R. R.
L. M. Henderson.

Restrictive Endorsements

Destroy the negotiable qualities of a paper. There are several forms of Restrictive Endorsements, a number of which we here give:

Pay to T. E. Burns
only.
T. M. Henderson.

Pay to T. E. Burns
for my use.
L. M. Henderson.

Pay to T. E. Burns
or order, for the use of
C. L. Weston.
L. M. Henderson.

Pay to T. E. Burns
or order, for collection.
L. M. Henderson.

WILLS—HOW MADE.

1. A will is the legal declaration of a person's mind as to the manner in which he would have his property or estate disposed of after his death. All persons of lawful age, possessed of sound mind, are legally qualified to dispose of their property by will.

2. A man making the will is termed the testator, a woman the testatrix.

3. No exact form of words is necessary in order to make a will good at law, though much care should be exercised in order that its language may not be misunderstood and it must be properly signed and witnessed.

4. A will is of no force until the death of the testator, and can be cancelled at any time by the maker.

5. The last will made annuls all former wills.

6. There are two kinds of wills, written and verbal. The verbal wills depend, for legality, upon proof of persons hearing the same. Verbal wills frequently cause trouble, and, even when well authenticated, often make expensive litigation. They should be discouraged.

7. A will made by an unmarried woman is no longer revoked by marriage, but in most States a husband would have approximately one-third interest in the real estate.

8. No husband can make a will that will deprive the wife of her right of dower, which is equal to about one-third of the real estate. At the wife's death it naturally falls to her heirs, if she dies without leaving a will. But the husband can will the wife a certain amount in lieu of her dower, stating it to be in lieu thereof. Such bequest, however, will not exclude her from her dower, provided she prefers the dower to the bequest made in the will. Unless the husband states distinctly that the bequest is in lieu of dower, the wife is entitled to both.

9. The estate of a deceased person must pay debts and funeral expenses before distribution can be made.

10. A person can insure his or her life in favor of any person, whether relative or otherwise, and in that event. such insurance cannot be taken for debts of deceased.

Will of a Married Woman.

A married woman has the right to dispose of her separate property by will the same as a married man. The only interest that she cannot will away, would be an estate that the husband would have in her property that would be equivalent to her interest in his estate at his death.

The person making a will may appoint his executor, but no person can serve as such executor if, at the time of the proving of the will, he be under twenty-one years of age, not of sound mind, or a witness to the will.

Short Form of Will.

In the Name of God, Amen.

I,____________________________of____________________in the County of____________________and State of____________________ being of sound mind and memory, and considering the uncertainty of this frail and transitory life, do therefore make, ordain, publish and declare, this to be my last **Will** *and* **Testament:**

First, *I order and direct that my Execut______hereinafter named pay all my just debts and funeral expenses as soon after my decease as conveniently may be.*

Second, *After the payment of such funeral expenses and debts, I give, devise and bequeath____________________________________*

____

____

Lastly, I make, constitute and appoint____to be Execut______of this, my last Will and Testament, hereby revoking all former Wills by me made.

In Witness Whereof, *I have hereunto subscribed my name and affixed my seal, the______________day of______________in the year of our Lord one thousand nine hundred____________________*

____________________________________[SEAL]

This Instrument was on the day of the date thereof signed, published and declared by the said testator____________________________to be h______last Will and Testament, in the presence of us who at h______request have subscribed our names thereto as witnesses, in h______presence, and in the presence of each other.

____

____

MARRIAGE LAWS AND CONTRACTS.

Marriage is a civil contract. Marriage licenses are required in all the States except New Mexico, New York and New Jersey, yet a marriage may be legal without it.

Breach of Promise.

CONTRACT TO MARRY IN THE FUTURE.—Mutual promise by a man and a woman to marry at some future day constitutes a valid contract, and a person breaking such a contract is liable in damages. Seduction of a woman of lawful age, under promise of marriage, and subsequent refusal to marry on his part is a crime and subjects the person so doing to heavy damages, and in some instances imprisonment.

Ante-Nuptial Contracts.

A man and woman can, previous to marriage, enter into a contract whereby either can waive all or a part of any interest that might come to them because of such marriage, in the property of the other. Such contracts are called Ante-Nuptial Contracts.

Divorce.

Violation of the marriage vow is cause for absolute divorce. The divorce laws of the different States vary greatly. Some of the principal causes for divorce are impotency, willful desertion, cruel and abusive treatment, habitual drunkenness, imprisonment for felony, failure by husband to provide, duress, insanity or idiocy, and ungovernable temper.

Divorce laws have been very lax, but public sentiment is rapidly forming against such laws, largely because of the interests of innocent children. As such sentiment grows, it will be necessary for each party to make more concessions to the other, which will naturally result in an assimilating of natures and final contentment. We hope such sentiment will continue to grow. It is a matter of statistics that in one of our States there were recorded in 1902 235 divorces to every 1,000 marriages.

The Right of Married Women to Own Property.

All property owned by the wife before marriage or received after marriage and held as her separate property, can be sold and transferred by her just the same as a husband can convey his separate property.

If a husband fails to make proper provision for the support of his wife, the law will compel him to furnish her proper support if he has sufficient property. In some States he can be arrested for failure to support his family.

The earnings of the wife are not liable for the debts of the husband except for family necessaries. The separate property of the wife is not liable for the debts of the husband, except for family necessaries.

The property owned by the husband before marriage, or acquired after marriage by gift of inheritance, is his separate property; but his wife, however, has a dower interest in the real estate.

The wife who deserts her husband without cause cannot hold him for her support, but upon good cause shown, she can get alimony or support. The earnings of the wife, provided the children are given to her by the court, after legal separation from her husband, are the property of the wife.

If husband or wife transfers real estate of any kind, both must sign the deed, mortgage or contract.

Law Governing Lost Notes.

If a person should refuse to pay a note which has been lost, he may be sued and compelled to pay it, but the party collecting it should indemnify the maker of the note against the possibility of having to pay it a second time.

When to Sign Your Name in Full.

In signing deeds, mortgages, wills and all kinds of contracts always write your name in full. Never use your ordinary business initials for signatures of this kind. For instance, instead of signing A. M. Miller, write Alonzo M. Miller.

How a Married Woman Should Sign Her Name.

A married woman should, on all business documents, sign her own name instead of prefixing a Mrs. to her husband's. For example, Mrs. Smith should sign Mary R. Smith and not Mrs. John Smith.

How Money Accumulates.

The following shows how easy it is to accumulate a fortune, provided proper steps are taken. The table shows what would be the result at the end of fifty years by saving a certain amount each day, and putting it at interest at the rate of six per cent:

DAILY SAVINGS.	THE RESULT.	DAILY SAVINGS.	THE RESULT.
One cent	$ 950	Sixty cents	$ 57,024
Ten cents	9,504	Seventy cents	66,528
Twenty cents	19,006	Eighty "	76,033
Thirty "	28,512	Ninety "	85,537
Forty "	38,015	One dollar	95,041
Fifty "	47,520	Five dollars	475,208

Nearly every person wastes enough in twenty or thirty years, which, if saved and carefully invested, would make a family quite independent; but the principle of small savings has been lost sight of in the general desire to become wealthy.

SHORT FORM OF MORTGAGE.

The Mortgagor,..
of this..*in the County of*............................
and State of...*MORTGAGE and WARRANT*
to..
of the...*County of*...................................
State of...............................*to secure the payment of*...........................
....
....
the following described Real Estate:
....
....
situated in the County of................................*in the State of*..........................
hereby releasing and waiving all rights under and by virtue of the Homestead Exemption laws of this State.

Dated the..................................*day of*..........................*A. D. 190*......

Signed, Sealed and Delivered in Presence of ....[SEAL]
....[SEAL]
....[SEAL]
....[SEAL]

STATE OF............................ } *ss.*
............................*County.* } *I*,..
.......................*in and for the said County, in the State aforesaid, DO HEREBY CERTIFY, That*..
personally known to me to be the same person...whose name.........subscribed to the foregoing instrument, appeared before me this day in person, and acknowledged that..he...signed, sealed and delivered the said instrument as..........free and voluntary act, for the uses aud purposes therein set forth, including the release and waiver of the right of homestead.

GIVEN under my hand and.....................................*seal, this*
..............................*day of*..............................*A. D. 190*......

....
....

Mortgage

....
....
TO
....
....

..............................*Recorder.*

By..............................*Deputy.*

CHATTEL MORTGAGE.

Know all Men by these Presents, *That I,......................... of the Town of......................... in the County of...................... and State of..........., in consideration of......................... Dollars, to........ paid by...................................... of the County of...................... and State of...................... the receipt whereof is hereby acknowledged, do hereby grant, bargain and sell unto the said.................... .... and to......... heirs and assigns, forever, the following goods and chattels, to wit: ....*

...

TO HAVE AND TO HOLD all and singular the said goods and chattels unto the said Mortgagee herein; and......... heirs and assigns, to their sole use and behoof forever. And the Mortgagor herein, for......... and for......... heirs, executors and administrators, do...... hereby covenant to and with the said Morgagee and........... heirs and assigns, that said Mortgagor.. lawfully possessed of the said goods and chattels, as of.............. own property; that the same are free from all encumbrances, and that............. will warrant and defend the same to.............. the said Mortgagee , and........... heirs and assigns, against the lawful claims and demands of all persons.

PROVIDED, nevertheless, that if the said Mortgagor shall.......................

...

...

then this Mortgage to be void, otherwise to remain in full force and effect.

AND PROVIDED, FURTHER, That until default be made by the said Mortgagor in the performance of the condition aforesaid, it shall and may be lawful for........... to retain the possession of the said goods and chattels, and to use and enjoy the same; but if the same, or any part thereof, shall be attached or claimed by any other person or persons, at any time before payment, or the said Mortgagor , or any person or persons whatever, upon any pretense, shall attempt to carry off, conceal, make way with, sell or in any manner dispose of the same, or any part thereof, without the authority and permission of the said Mortgagee , or.............. heirs, executors, administrators or assigns, in writing expressed, then it shall and may be lawful for the said Mortgagee , with or without assistance, or........ agent or attorney, or heirs, executors, administrators, to take possession of said goods and chattels, by entering upon any premises wherever the same may be, whether in this County or State, or elsewhere, to and for the use of said Mortgagee , ... heirs or assigns. And if the moneys hereby secured, or the matters to be done or performed, as above specified, are not duly paid, done or performed at the time and according to the conditions above set forth, then the said Mortgagee , or......... attorney or agent, or......... heirs, executors, administrators or assigns, may, by virtue hereof, and without any suit or process, immediately enter and take possession of said goods and chattels, and sell and dispose of the same at public or private sale, and after satisfying the amount due, and all expenses, the surplus, if any remain, shall be paid over to said Mortgagor or........ heirs or assigns. The exhibition of this Mortgage shall be sufficient proof that any person claiming to act for the Mortgagee is duly made, constituted and appointed agent and attorney to do whatever is above authorized.

IN WITNESS WHEREOF, the said Mortgagor ha hereunto set............. hand and seal , this...................... day of...................... in the year of our Lord one thousand nine hundred and...............................

Signed, Sealed and Delivered in Presence of } ....[L. S.]
....[L. S.]

No..............

Chattel Mortgage

....

TO

....

STATE OF...................} ss.
County of...................

This Instrument was filed for Record on the..............*day of*............ *A. D. 190... at the hour of*........*o'clock* ... *M. and duly recorded in Book*.......... *of Chattel Mortgages, Page*..........

..............................*Clerk.*

By..............................*Deputy Clerk.*

STATE OF......................} ss.
..................................*County.*

This Mortgage was acknowledged before me, by...
....*and entered by me this*......................*day of*
....*190*...

....

THINK TWICE BEFORE YOU GIVE A MORTGAGE.

WARRANTY DEED.

The Grantor,..
of the.................................. ....*in the County of*..................................
and State of ....*for and in consideration of*
....*Dollars, in hand paid, CONVEY... and*
WARRANT... to...
....*of the* ....
County of......................................*and State of*..................... ....
the following described Real Estate, to wit :...
....
....
situated in the County of...*in the State of*...........
hereby releasing and waiving all rights under and by virtue of the Homestead Exemption laws of this State.
....
....
Dated this..................................*day of*................................*A. D. 190...*

Signed, Sealed and Delivered in Presence of

....[SEAL]
....[SEAL]
....[SEAL]
....[SEAL]

BACK OF WARRANTY DEED.

STATE OF............................. }
.....................................*County.* } *ss.* *I,*..
....*in and for the said County, in the State aforesaid,*
DO HEREBY CERTIFY, That.. ....
....
personally known to me to be the same person whose name.................*subscribed to the foregoing instrument, appeared before me this day in person and acknowledged that*.....*he*.....*signed, sealed and delivered the said instrument as*.................*free and voluntary act, for the uses and purposes therein set forth, including the release and waiver of the right of homestead.*

[SEAL]

GIVEN under my hand and............................
seal, this.................*day of*.................*A. D. 190...*

....
....

LEASE FOR PROPERTY—SHORT FORM.

This Indenture, *Made this............................day of............................190 ,*
BETWEEN..
party of the first part, and...
....
party of the second part, WITNESSETH: that the said party of the first part, in consideratiou of the covenants of the said party of the second part, hereinafter set forth, do by these presents lease to the said party of the second part the following described property, to wit:
....
....
TO HAVE AND TO HOLD the same to the said party of the second part, from the.................day of.................190 , to the.................day of...............190 .
And the said party of the second part, in consideration of the leasing of the premises as above set forth, covenants and agrees with the party of the first part to pay the said party of the first part, as rent for the same, the sum of.......................................
Dollars, payable as follows, to wit: ....
....
....
The said party of the second part further covenants with the said party of the first part that at the expiration of the time mentioned in this Lease, peaceable possession of the said premises shall be given to the said party of the first part, in as good condition as they now are, the usual wear, inevitable accidents and loss by fire excepted; and that, upon the non-payment of the whole or any portion of the said rent at the time when the same is above promised to be paid, the said party of the first part may, at..........
...........election, either distrain for said rent due, or declare this Lease at an end, and recover possession as if the same was held by forcible detainer; the said party of the second part hereby waiving any notice of such election, or any demand for the possession of said premises.

AND IT IS FURTHER COVENANTED AND AGREED, Between the parties aforesaid...
....

The covenants herein shall extend to and be binding upon the heirs, executors and administrators of the parties to this Lease.

Witness the hands and seals of the parties aforesaid.

....[SEAL]
....[SEAL]
....[SEAL]

LEASE

....

TO

....

From.......................190

To..........................190

LAW REGARDING HIRED HELP.

If a man is hired without any special bargain as to the price, he is entitled to the current wages for such labor, and no more; but every laborer may not be aware that if he engages to work "for a year," but leaves without good cause at the end of eleven months, he is not, in most States, legally entitled to any compensation for what he has done, but forfeits the whole; and this is so whether he has agreed to stay for the entire year at one round sum, or for a year at the rate of twenty dollars a month.

If the bargain is to work for more than a year or even for just a year, but to begin at some future day, as a week after making the bargain, and the contract is not written down and signed, it is not binding on the laborer and he can break it from a mere whim and still make the farmer pay. In like manner, if the laborer is under twenty-one, he is not bound by his bargain, but may desert when he pleases and recover "back pay." And this is so, although the young man appears to be of age, or is married and has a family, or even though he falsely stated he was over age and able and willing to make a good bargain.

Always have a regular account of a hired man, keeping record of time he begins work, the date and amount drawn, time lost, etc.

LAW REGARDING FARM ANIMALS.

It is not generally known that every man must keep his cattle on his own land at his peril. He is liable if they stray away into other people's grounds. It is necessary, therefore, at common law, that every man should keep watch over his animals, or surround his land with a fence. This fence is primarily, therefore, not to keep other people's cattle out, but to keep his own in.

Vicious Animals.

If a man turns his animals loose into the public highway, and they there injure the person or property of another lawfully using the highway, the owner is responsible for all damages they may do, whether he knew they had any dangerous disposition or not. He had no right to let his cattle run loose in the public highway.

In like manner, if a boy, while robbing an orchard, is tossed by a vicious bull into the boughs of the apple tree overhead, the owner is as much liable in law to pay for the boy's torn trousers as if he had received the same salutation when coming up the path in broad daylight.

In one instance a farmer, who was much annoyed by strolling fishermen, put a savage bull into the lot along the stream. As one of his neighbors was remonstrating with him that he ought to give strangers notice what kind of animal it was he remarked, "The fellow will give them notice enough himself"; but as his notice was rather too brief, the farmer had to pay five hundred dollars for two broken ribs.

Liability for Animals on One's Own Premises.

Every owner of a dangerous or vicious horse or animal known to be such is liable for all injury he may do to another, even though the latter is at the time trespassing on the former's

premises. If, therefore, a man while hunting through your woods, is attacked and bitten by your savage dog, you must pay for the pound of flesh, although you did not set him on. You should have posted up the advice, BEWARE OF DOGS.

Runaway Horse.

If a man's horse runs away in the street and injures some one or breaks a carriage, the owner is not liable, unless he carelessly left him unhitched or was guilty of some other negligence.

Law about Dogs.

If your dog rushes out into the street and in mere play jumps at a horse's head, whereby he is frightened and runs away, breaking the carriage and perhaps the limbs of the occupants, you are responsible for double the amount of the entire damage, though it amount to several thousand dollars; for the liability of the owner is not limited to damages from the bite of a dog, but extends to any direct injury, however caused.

In the case of trespassing dogs, cats, hogs, and such animals, the right to kill such animals is not confined to the very moment when they are in pursuit, or about immediately to attack the farmer's animals, but if, from their habits or former conduct, there is good reason to believe one's own property is in danger, a man need not wait until the dog has the lamb by the throat, or the cat has the chicken in its mouth, before he can fire.

Law about Scratching Hens.

You have not a right to kill your neighbor's hens while scratching up your melons and cucumbers. The custom of doing so, and tossing the fowls over the fence may afford some satisfaction to the gardener, but it makes him liable to pay the full value of the nuisances, although he had repeatedly warned their owner to keep them at home or take the consequences.

A farmer in Connecticut, who had been annoyed by his neighbor's hens scratching up his garden seed, spread a quantity of Indian meal mixed with arsenic on his own land, which had the effect designed, but he had to pay for the fowls.

Shooting an animal merely because it is trespassing on your grounds and injuring your crops is not justifiable.

A farmer has a right to kill the animals of another if they are in pursuit of his own and there is reasonable ground to apprehend that they will attack and destroy or carry them off.

LAW REGARDING OVERHANGING TREES.

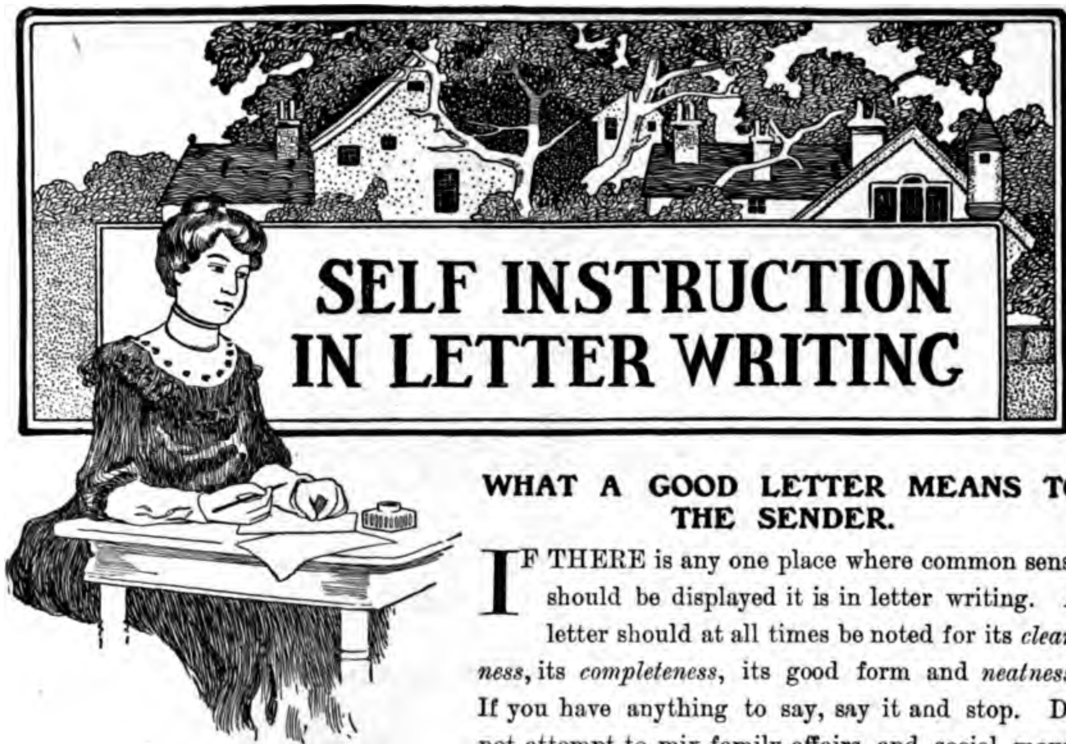
It is generally supposed that the fruit on the limbs overhanging one's land belongs to him, but this is an entire mistake.

If a tree stands wholly on your land, although some of the roots extend into the soil of your neighbor, and derive support and nourishment from his soil, he has no right to any of the fruit which hangs over the line; and if he attempts by force to prevent you from picking it, he is liable for an assault and battery.

In one instance a lady while standing on the fence picking cherries which hung over the line, was forbidden to do so by the adjoining owner who was at work in his garden; and in the scuffle to prevent her, she received some bruises on her arm, for which he had the pleasure of paying the neat little sum of a thousand dollars. If your fruit falls into your neighbor's lot, you have an implied license in law to go and pick it up, doing him no unavoidable damage.

If a fruit tree stands directly on the division line and is what is called a "line-tree," both parties own the tree and the fruit in common, and neither can cut down the tree or seriously injure it, without being responsible to the other.

TALKING IT OVER.



WHAT A GOOD LETTER MEANS TO THE SENDER.

IF THERE is any one place where common sense should be displayed it is in letter writing. A letter should at all times be noted for its *clearness*, its *completeness*, its good form and *neatness*. If you have anything to say, say it and stop. Do not attempt to mix family affairs and social movements with an order for groceries or dry goods. If you desire a firm to ship you a barrel of sugar, it is not an essential thing to its early shipment that you inform them about the crops, or tell them that you will make it a point to come and see them when you come to the city. Be brief, but at no time at the sacrifice of clearness. Be plain and natural. Do not attempt to show your friend at the other end of the postal route how many fancy side-steps in ornamental penmanship you can use. High-flown capitals with lots of shade are regarded as instability of character and wastefulness. Whether this be true or not we do not know, but we do know that it indicates unwarranted egotism.

A Silent Witness.

When you write a letter remember that what you say is a silent witness that never forgets. Hence, be it ever so painful, speak the truth. Use good language. By this we do not mean big words, for big words are very often a sign of little ideas; and last, but perhaps the most important of all, be careful of your spelling. We do not all have the opportunity to learn Latin or Greek, algebra or geometry, philosophy or rhetoric, but there are very few of us that do not have an opportunity of learning how to spell, especially when a twelve pound dictionary can be bought for $1.79. People take it that you should know how to spell, and if you do not, you are at once branded as an ignoramus. While this is often unjust, perhaps, yet it is nevertheless true. You cannot more effectually brand yourself an anarchist by flaunting a red flag and allowing the hair to cover your face, than you can tell to the world that you are uneducated and lazy by misspelling a few common words.

BUSINESS LETTERS.

A large portion of commerce and trade is brought about through the medium of correspondence. Statistics tell us that eighty per cent of the world's trade is on paper. Yet there is unhappily no branch of learning that has been more neglected by the average individual than the branch we call letter writing. Were you to enter one of the large business establishments in our cities and devote a few minutes in the morning to looking over the mail as it comes from every point of the compass, you would but be impressed with the fact that so few know how to write a good letter, and that so many are "outrageously awful" in the makeup of their communication which they expect the business man to entirely understand.

First Essential to Good Letter Writing.

It will be our attempt in the pages following to illustrate some of the more common forms in the hope that a better grade of writing will result. First impressions are very important, hence we deem it that the first essential for good letter writing is good material. As a carpenter cannot work without sharp tools, as the farmer cannot till the soil with a rusty plow, so a writer of a letter cannot expect good results from using wrapping paper, a stub pen and red ink.

The selection of paper depends largely upon the writer and somewhat upon the purpose of the letter. The color is immaterial, providing, of course, that it is modest. The size is not an absolute essential to good work, but for business letters letter-head stock should be used. This is paper 8x10 inches in size.

For letters of friendship the smaller size is preferable, either 6x9 inches, or any size sold for that purpose. The envelope should be of the same color and large enough to admit easily the letter folded *once from the bottom to within an eighth of an inch from the top, and then one-third of its width from each side*, or for note paper, one-third of the way from the bottom and one-third from the top.

As to size and style of pen to be used we would disagree; a penman would order a fine pen, a business man a coarser one. Fountain pens are coming into much use, but for those who write a great deal it seems to us that the essential is a clean pen and the same kind used at all times.

As to ink—always a free flowing black. It is always a mark of the lack of taste to use bright colors. One author has expressed it that "red ink always looks green" when used to write a letter. Red ink has its purpose. The bookkeeper knows what it should be used for.

PARTS OF A LETTER—Heading.

First the *heading*, or part which names the place in which the letter is written and the date of writing, is placed about two inches from the top of the sheet, as is illustrated below, and should be arranged to occupy two or three lines, according to the number of words composing it. The punctuation consists of a comma, used between the parts, and a period at the closing. The name of the month and the number of the day of the month are consid-

ered as one word, and no comma should be placed between them. Note carefully the following models:

1.

Denver, Colo., June 1, 1904.

2.

Glengarry Cottage, Hyde Park,
Chicago, Ill., November 15, 1904.

3.

Bowman Hall, Cornell College,
Mt. Vernon, Iowa, July 1, 1903.

The Address.

It is just as essential that at this point you place the *address* as it is that you later put it on the envelope. It should be the same, except, perhaps, that some of the parts may be omitted, such as street or room number. A good reason for placing it in the letter is that the person receiving it very often discards the envelope, and yet has evidence that the letter is intended for him. Another very important fact is that the envelope may, by accident or otherwise, have had an illegible address, and will be sent, as a result, to the dead letter office, to which point hundreds of thousands of letters are sent every year, because of imperfect addresses. The officials in the office, when they have found the address at the beginning of the letter, will at once forward it to the proper person.

The address should begin about one-half inch from the marginal line of the paper. Some good authors contend that it should begin about an inch from the marginal line. However we will not quarrel with them. If you begin about one-half inch from the margin it will mean that the paragraph should begin one inch from the margin. Should you begin the address one inch removed from the margin, then begin your paragraph two inches from the same margin, the essential point being uniformity—harmony, if we may be allowed to so call it, for we feel that there is a thread of it running throughout letters, should be as carefully observed as a delicate note on the piano. The first line of the address consists of the name of the person, preceded by or followed by a title of courtesy. The second line gives the postoffice address, which may be omitted if the person lives in the same place as the writer. The address should be punctuated with commas between the parts and a period at the close.

Salutation.

Salutation is the greeting of respect, courtesy, or love, which immediately precedes the body of the letter. It may be begun either immediately below with the same margin as the first line of the address, or if desired, it may be placed on the line half way between the first and second lines of the address. The usual form is the first named. If a salutation consists of two words, every word must be capitalized; when it has three words the middle word need not be capitalized unless it be a proper name. The salutation may be followed by a comma,

or a comma and dash. If written on the typewriter a colon and dash is used. We could never discover the reason for using a dash when the salutation was on a separate line from the body of the letter. If the body of the letter immediately follows the salutation it would be understood why the dash is used. However, this is a matter of detail, hence is not worthy of our discussion. Note carefully the following models:

(Heading)

(Address)

(Salutation)

(Body of Letter)

(Paragraph)

(Complimentary Close)

(Signature)

Body of Letter.

The *body* of a letter is that part which conveys, or should convey, your mission. It usually begins just below your salutation, but may begin immediately thereafter. No margin should be left on the right-hand side of the paper, the writing being continued to the very edge, or as nearly so as possible without crowding the word. This rule does not apply to typewritten letters, where often the margin is stopped on both the right and left sides. When a new subject is introduced or a paragraph formed, the first word of the paragraph begins on the next line below with a margin twice as deep as that used for the other divisions of the letter. The paragraphs depend entirely upon the judgment of the writer. They are of no certain length, and it is most essential that you make no division in thought in paragraphing. It is also essential that the paragraphs be not too long.

Complimentary Closing.

The *complimentary closing* is an expression of courtesy which ends the letter. The number of words that can be used are so numerous that we will not attempt to say which is preferable. This division of the letter should be placed on the line below the body of the letter in about the center of the sheet.

Signature.

The *signature* is written on the line below the complimentary closing, just a little to the right.

1.

Yours truly,
J. L. Brown.

2.

Respectfully yours,
Howard B. James.

3.

With best wishes, I remain,
Your sincere friend,
Harry Jones.

4.

Very respectfully yours,
(Miss) Mary Anderson.

Directing and Stamping.

Below we give illustrations for the proper address on the envelope. Some good authorities will disagree with us as to where the address should begin, but again we have reached a non-essential point. A few years ago, in the city of Chicago, a large convention devoted an hour and a half to deciding the momentous question as to whether there was any finger movement in the tail-end of the figure 6. Alas, it is yet unsettled, and the countless millions will pass into eternity without its being decided! So in the address of the envelope. We believe that the following forms are plain and clear, and that an envelope addressed as they are, will reach its destination. There is one great caution in envelope addressing: Be sure to begin the address at least as far down from the top of the envelope as is indicated by any of the forms here given. Many times a letter must go to the Dead Letter office because the name has been obliterated by the stamping machine. There is but one word to say relative to the stamp: wet it with a sponge, and have respect enough for the "Father of his Country" to put him right-side-up on the envelope.

MR. JAMES WHEATON,

HAMILTON,

ILL.

MR. CHAS. W. MARSTON,

1640 JEFFERSON ST.,

CHICAGO, ILL.

THOMAS H. DENTON,

Gen'l Passenger Agt., B. & O. R. R.,

BALTIMORE,

Cor. Baltimore and Calvert Sts. MD.

BUSINESS LETTERS—SERIES NO. 1.

No. 1. Ordering a Bill of Goods.

Clinton, Iowa, Jan.....19..

Marshall Field & Co.,
Adams and Fifth Ave., Chicago, Ill.

Gentlemen:—

Please forward by United States express the following:

1 bolt black Venetian cloth, best quality,
1 bolt heavy navy blue cheviot.

Terms cash on receipt of goods.

Very respectfully,
James R. Hill & Co.

No. 2. Advising Receipt of Invoice.

Chicago, Ill., Jan....19..

James R. Hill & Co.,
Clinton, Iowa.

Gentlemen:—

Your order of the....inst. at hand. Enclosed, find invoice for same, amounting to $64.50.

Trusting that goods will arrive in good condition, we are,

Very respectfully,
Marshall Field & Co.

No. 3. Sending Remittance.

Clinton, Iowa, Jan....19..

Marshall Field & Co.,
Adams and Fifth Ave., Chicago, Ill.

Gentlemen:—

Enclosed, find Chicago exchange for $64.50, in payment of your invoice of....inst.

Kindly return receipted bill and oblige,

Yours respectfully,
James R. Hill & Co.

No. 4. Acknowledging Remittance.

Chicago, Ill., Jan....19..

James R. Hill & Co.,
Clinton, Iowa.

Gentlemen:—

Enclosed, find receipted bill in exchange of your draft for $64.50, received to-day. Accept our thanks for your prompt remittance. Trusting that we may again favor you in trade, we are,

Very respectfully,
Marshall Field & Co.

The above forms are not of necessity to be considered as models, but convey to you the fact that every order for goods must have at least four letters to complete the round of a commercial transaction where that transaction is performed through the mail. In fact when a verbal arrangement is made in a store, you must ask, in a polite manner, for your goods; they will then be delivered; you will next pay for them; lastly, if the merchant has an eye for business he will thank you.

BUSINESS LETTERS—SERIES NO. 2.

While we must have at all times at least four letters for the purpose of completing an order, the transaction may branch out into many more, as is illustrated in the following series. The first letter, which at first glance, appears to be identical with the first in Series 1 is in fact very different, in that the terms are not mentioned, and we will presume the writer to be a stranger to the concern.

No. 1. Ordering Goods on Credit.

Denver, Colo., Jan....19..

Sprague, Warner & Co.,
Chicago, Ill.
Gentlemen:—

Please send me at your earliest convenience the following bill of goods:

1 bag (100 lbs.) best Mocha and Java coffee.
½ chest Y. H. tea.
4 bbls. H. & H. granulated sugar.

Forward same by C., B. & Q. fast freight.

Respectfully,
John Smith.

No. 2. Refusing to Fill Order and Asking for References.

Chicago, Ill., Jan....19..

Mr. John Smith,
Denver, Colo.
Dear Sir:—

Your favor of the....inst., containing order for goods duly received. We would be glad to fill this order at once and forward to you as directed were it not for the fact that you are an entire stranger to us, and we find that you have no rating in such mercantile books as we possess.

The rules of our house require that before opening Ledger accounts with strangers they must either have a sufficient rating to warrant us in making the shipment, or provide us with references. If you will kindly wire us, at our expense, the names of other merchants in this city with whom you are doing business, or those of your city to whom we can refer, we will be glad to ship your order at once.

Trusting that you will at once recognize the business sense of our proposition, and hoping to be able to serve you to your advantage, we are,

Very respectfully,
Sprague, Warner & Co.

No. 3. Letter Giving References.

Denver, Colo., Jan....19..

Sprague, Warner & Co.,
Chicago, Ill.
Gentlemen:—

We have this day wired you names of several merchants in this city who will vouch for our credit. As the order we gave you was the first to have been sent to your house, we should have arranged our standing with you. We trust that the names sent will prove a sufficient guarantee.

We have recently opened our business here, and hope to be able to meet all bills promptly. Trusting that you will forward the goods at your earliest convenience, we are,

Very truly yours,
John Smith.

No. 4. Letter Requesting Payment.

We will now assume that the firm, feeling warranted in forwarding the goods, have done so, and have sent an invoice amounting to $146.40, the terms of which are 30 days, or three per cent discount if paid in ten days. Thirty days have now elapsed, the remittance has not arrived, and a statement will be sent. Fifteen days later, not having received any remittance, a mild dunning letter is forwarded, something after the following order:

Chicago, Ill., Jan....19..

Mr. John Smith,
Denver, Colo.

Dear Sir:—

Your account, amounting to $146.40, is now past due. We will be grateful to you for a remittance.

Thanking you in advance, and assuring you of our appreciation of past favors in trade, we are,

Very truly yours,
Sprague, Warner & Co.

No. 5. Second Request for Payment.

Not yet hearing from him, a letter somewhat after this order would perhaps be mailed in fifteen or thirty days:

Chicago, Ill., Jan....19..

Mr. John Smith,
Denver, Colo.

Dear Sir:—

We find that you are indebted to us to the amount of $146.40. We are in need of cash, and trust that you will be able to pay in full at once.

If you cannot settle in full, please send a check for whatever part you can spare, and we will be glad to arrange the balance in a satisfactory manner.

Yours very respectfully,
Sprague, Warner & Co.

No. 6. Drawing upon Debtor through the Bank.

A sufficient time rolls by for the debtor to have paid some attention to the communication from the company, but failing to do so, it perhaps would be well at this juncture to forward another statement, stating in it a date upon which you will draw upon them for the amount of their indebtedness. This might be followed by a letter somewhat after the following:

Chicago, Ill., Jan....19..

Mr. John Smith,
Denver, Colo.

Dear Sir:—

We send to-day to the Citizens' Bank of your place, for collection, a sight draft on you for $146.40, the amount of your indebtedness to us in full, believing that you will find this the correct amount, and trusting that you will honor our draft, we remain,

Very truly yours,
Sprague, Warner & Co.

No. 7. Letter Giving Notice of Placing Account in Hands of Attorney.

So far the spirit of courtesy and kindness has pervaded the letters to the debtor. It must continue so, "for more flies are caught with molasses than vinegar." Yet we must be stern, and should he fail to respond to this last appeal, and the draft be returned to us dishonored, something after the following order might be well:

Chicago, Ill., Jan....19..

Mr. John Smith,
Denver, Colo.
Dear Sir:—

We regret exceedingly that the draft sent you on Jan....has been returned to us dishonored.

We do not understand why you have taken this position in the matter. We have endeavored to treat you courteously, and will continue so to do, but unless we hear from you within ten days of this date it will be our unpleasant duty to place your account in the hands of an attorney for collection.

Trusting that we may not be obliged to take this step, we remain,

Respectfully yours,
Sprague, Warner & Co.

No. 8. Placing the Account for Collection.

Still the gentleman refuses to give the desired answer. Perhaps the following letter would stir him up, but let it be distinctly understood that no good business man will make an assertion that he will not carry out to the letter, and if you desire to sue the account, say so, *then do it.*

Chicago, Ill., Jan....19..

Mr. John Smith,
Denver, Colo.
Dear Sir:—

Not having received a reply to our numerous communications we take it that you do not intend to pay your account unless obliged to do so.

We have, therefore, to-day given your account to our attorneys, Messrs. Swift & Wilson, with positive instructions to bring suit within ten days.

Respectfully,
Sprague, Warner & Co.

These letters will give to the reader some idea of the forms usually pursued by the business house. The great point that we have endeavored to keep before you, however, is that thorough courtesy must be apparent throughout your entire correspondence. The letter that calls for more tact, thought and care on the part of the business man, than almost any other that can be presented, is the dunning letter. You may offend a good customer, poor but honest. You are in business for trade. You want his future orders. Of course, if you have sold to him and then find that his account is worthless there is no need in sending good money after bad, and wasting postage, but charge his account to experience.

MISCELLANEOUS LETTERS.

"Follow-ups."

There are a great many important letters that might here be given, but it is not the purpose of the author to give a "Handy Letter Writer." There are too many such books. By their use thought is often stifled, and that which you intend to convey remains only in your mind, and the reader of your letter is in the dark. A good rule to observe in all letter writing is. Write, not that the reader may understand, but that he must understand all that you desire him to Among the letters that are now considered as essential among business men are those commonly known as "follow-ups." They are presumed to be, and in fact are, trade-getters, for the business man has long recognized the fact that "keeping everlastingly at a thing brings success."

This rule will not, however, hold good unless the letter carries with it a conviction that the writer thereof believes in himself and in what he has to offer to the trade. We come in contact every day with letters that, because of their poor appearance, are consigned to the waste basket. Yet the one who writes the letter may have as good, or better, articles to sell than he who is able to favorably impress you by his first note. This does not logically follow, however. It is generally true that he who writes on good paper, shows neatness and carefulness in what he says and how he says it, is the individual who has the better grade of goods. It is impossible for us to give herewith model forms for the "follow-up" series. What will do for a furniture dealer is not appropriate for the hardware merchant; what would sell your farm would not sell a scholarship in a school. Should you find that you will have occasion to use a "follow-up" system our only advice would be: Write the best you can, read what you have written, carefully, and then tear up the letter and write another, for in this, as along other lines of education, intelligent practice makes perfect.

LETTERS OF APPLICATION.

It is said that "political platforms are built to get in on." Whether this be true or not we will not contend, but we do know, however, that letters of application are written for the purpose of "getting in." The busy business man has little or no time to interview the one hundred and one applicants in person, if he desires the assistance of some one in his work. Hence he does one of two things—advertises, or, if it be for clerical help, applies to some school that makes it its business to prepare young men and women for commercial pursuits. If his advertisement appears it is very rare that it will be found ending with his name. Usually he has the letters addressed in care of the newspaper, and then carefully looks them over, and calls for those whose letters impress him favorably.

It was the privilege of the writer some time ago to look over some 600 applications for a position. The business man who had advertised first opened the letters and flattened them out on the table in front of him, and then started in with his examination, and almost at a glance divided the letters into three divisions: the first for the waste basket, the second for

WANTED.

BOOKKEEPER AND STENOG.—FIRST-class; $12. 402 Ft. Dearborn Bldg.

BOOKKEEPER—YOUNG LADY; GOOD Penman. 92 La Salle-st.

CASHIER AND BOOKKEEPER—EXPERIenced woman, in manufacturer's office; must have ability and thorough knowledge of office routine; state salary required and full particulars. Address O 344, Tribune office.

CASHIER—RESTAURANT; 28 OR 30 YEARS of age; must give bonds. Address O 222, Tribune office.

GENERAL OFFICE WORK—YOUNG LADY; good penman; experienced; $7 to start. Address O 214, Tribune office.

GENL. OFFICE LADY—EXP., FOR GOOD, permanent West Side position; short hours. 402, 134 Monroe-st.

GIRL—AS ASSISTANT IN OFFICE LAUNdry on West Side; state age, experience, and references. Address P W 279, Tribune office.

LADY—NOT UNDER 25, OF GOOD EDUCAtion and prepossessing appearance, for permanent and responsible position; best of references required; salary $50 monthly to start. Call after 9, Suite 412, 203 Michigan-av.

AN EXPERIENCED INSTALLMENT COLlector for country; single. Address, stating age, experience, if single, and salary wanted. Address T C 350, Tribune office.

BY A RELIABLE PUBLISHING HOUSE, A man for stockroom and billing; must have had experience in packing, a good writer, and a hustler; salary to start, $7 to $8; steady position; must have A1 references. Address O 210, Tribune office.

moderate consideration, the third to be carefully scrutinized. When he had finished there were of the 600 letters over 400 of them in the first named pile, while but twenty-six were in the third lot, and of the twenty-six five were called in to talk the matter over with the proprietor. This should serve, we believe, as a sufficient lesson to use care and thought and time in your letter of application.

The president of one of the leading schools desired a teacher. He received 156 applications for the place. He consumed six weeks in writing back and forth with a number of them. At the end of the sixth week the one hundred fifty-seventh teacher applied. His letter was complete. It contained all the needed information—his age, his previous experience, references, salary desired, when he could report for duty, and other essential details—which so favorably impressed the president of the school that he at once wired him that his terms were accepted, and that he would expect him upon a certain date. It is not necessary to give your family history, yet it is essential that you make it unnecessary for the proprietor to write you for information that you should have at first given. Some one of the many applicants will furnish him with the necessary data, and will, as a result, get the place.

Letters of application should not only be carefully and courteously written, but they should be sparingly written. Do not apply for a position unless you feel competent to fill it. Do not boast of attainments that you hope to possess. If you can "deliver the goods" have no fear in so stating, but be very careful that your letter does not smack of boasting. If you have testimonials from others who know of your qualifications, enclose with your letter copies, never the originals unless desired to do so, and if they are, enclose also self-addressed stamped envelope for their return. Keep before you the one thought—that the only safe way to secure favorable consideration is to be the best.

LETTERS OF RECOMMENDATION.

The ordinary letter of recommendation is fast falling into disrepute. Many irresponsible persons are very careless as to whom they recommend, or if applied to, many fear to offend by not giving the desired letter. Hence the business man has often received, from applicants for a small clerkship, letters of recommendation as strongly worded and as flatteringly embellished as though the person presenting it was an applicant for the superintendency of

the universe. The writer of a recommendation should recognize the responsibility that he has taken upon himself when he signed the letter; his own reputation is involved as well as the one who receives the letter. He should, therefore, refuse all unworthy persons, that the worthy ones may get their just reward. In determining the worth of an individual, the position desired should be considered. A person may be recommended for special qualities that will fit him for one place and make him decidedly incompetent for another. It is not in harmony to recommend a blacksmith for a position that requires fine penmanship. True, it is hard to refuse a recommendation, yet much better to refuse than to deceive.

A young man may have confidence in your judgment, and if you recommend him for a position he may have a feeling of fitness, therefore, that he would not otherwise have had, and when later he finds that you have overestimated his abilities he discounts your word, and you have lost two friends—the proprietor and the applicant. There is also a responsibility resting upon the reader of the testimonial. He must not assume that the writer intends to recommend for anything other than the qualifications incident to the position. If the letter says that the young man is honest and upright, it does not mean that he is a rapid figurer, or that he will develop into a first-class accountant. True, it means much for his future to have this statement made, but he should not hold the writer responsible for anything that he does not say.

LETTERS OF INTRODUCTION.

A letter of introduction is very similar to a letter of recommendation. Do not give a letter of introduction to anyone whom you would not introduce in person. The letter should be short, should be placed in an envelope addressed, but not sealed, and should have on the lower left-hand corner, "Introducing Mr. ——." This prevents embarrassment on the part of the holder of the letter, and he is at once known on its presentation. Who and what he is will be learned by reading the letter.

That the person receiving such a letter may know at a glance its character, the letter should, on the envelope, be addressed thus:

Mr. John M. Teller,
321 Broadway,
Introducing *New York.*
L. W. Thompson,
of Chicago, Ill.

Forms of "Letters of Introduction."

1.

Chicago, Ill., August 1, 19..

Messrs. Smith & Thompson,
208 Broadway, New York.

Gentlemen:—

This will introduce to you my friend, Mr. Charles Smith, who intends to establish a business in your city. You will find Mr. Smith to be thoroughly honorable and trustworthy. Any favors that you can bestow upon him in the way of securing business or social acquaintances, will be highly appreciated by me.

Very truly yours,

2.

Cedar Rapids, Iowa, June 1, 19..

Marshall Field & Co.,
Chicago, Ill.

Gentlemen:—

This will introduce to you Mr. George R. Smith, of our city, who goes to Chicago for the purpose of buying a stock of dry goods. We have asked him to call upon you. Any special favors that you can extend during his stay in your city will be appreciated by me.

Yours truly,

LETTERS OF CREDIT.

Letters of credit are very similar to letters of introduction. The following forms will give you a general idea of their requirements:

1.

Chicago, Ill., April 12, 1903.

John V. Farwell & Co.,
Chicago, Ill.

Gentlemen:—

This will introduce to you Mr. William R. Smith, who desires to purchase a bill of goods. Please allow Mr. Smith such credit as he may desire, the amount not to exceed $3,000, for which I will become personally responsible. Should Mr. Smith make any purchases please notify me at once, giving the amount of the purchase.

Very respectfully,

2.

Chicago, Ill., July 12, 1902.

Mr. John V. Farwell & Co.,
Chicago, Ill.

Dear Sir:—

Please allow the bearer, Mr. Charles Walker, to have such goods as he may desire, the amount not exceeding $200. Charge the same to his account, extending him a credit of 60 days. If at the end of 60 days Mr. Walker has not paid for the goods send to me the amount of the invoice and I will remit in full therefor.

Very respectfully,

SOCIAL LETTERS—WEDDING INVITATIONS, ETC.

Formal.

WEDDING INVITATION:

MR. AND MRS. E. C. JOHNSTON
REQUEST YOUR PRESENCE
AT THE MARRIAGE OF THEIR DAUGHTER
MADGE
TO
JOHN F. WALLACE
TUESDAY EVENING, FEBRUARY 7TH, 1903
AT THE M. E. CHURCH
DIXON, ILL.

The wedding invitation is either written or printed, and in the form of a request of the parents or nearest friends of the bride for the presence of the person addressed. It is usually held at the residence of the person or persons issuing the invitation. The invitations are usually sent out about two weeks in advance of the nuptials. After the wedding a brief note or card is issued stating the fact and date of marriage and the time and place in which the new couple will be at home to their friends.

EXAMPLE:

MR. JOHN F. WALLACE
MISS MADGE JOHNSTON
MARRIED
TUESDAY EVENING, FEBRUARY 7TH, 1903
DIXON, ILL.

The above is a formal or set form, differing as you will note from the ordinary letter, in that it is written in the third person. The date is near the close, and it has no signature. Below we give a number of the common informal social forms:

Informal Letters.

Informal notes differ from the formal in that they are headed in exactly the same way as the ordinary letter, and are written in the first person. Example:

Monday Morning, June 12.

Dear Friend:—

We are going to take a tally-ho ride through the parks this afternoon. Will you not add to our happiness by making one of our little party? If so, we will call for you at 1:30 o'clock.

Your friend,

IMPORTANT SUGGESTIONS IN LETTER WRITING.

In order to secure prompt and correct delivery use street and number in writing addresses.

Write name of State in full.

When changing your address notify the postoffice in writing, giving both the old and new address.

Always register valuable matter.

Invariably place your name and address in upper left-hand corner of letter, envelope, newspaper or package wrapper.

Remit money by money orders.

Do not enclose with third or fourth class mail matter (i.e., catalogues or merchandise) letters or other writing, as by so doing you will subject the entire package to letter rates or postage. Third and fourth class matter is inspected and detained for improper enclosures. No writing other than the address and return card is permissible on the covers of third class matter.

Matter sealed against inspection is rated as first class. This should be borne in mind when matter other than first class is to be mailed.

The postoffice is not responsible for mail matter placed *on* a mail-box. It must be dropped *into* the box.

Put the proper amount of postage on mail matter.

When a letter is mailed in an envelope bearing address of a hotel, college or club, the name of the sender should be added to insure its return if undeliverable, otherwise it will be sent to the Dead Letter office.

GOOD ENGLISH FOR POLITE SOCIETY.

ENGLISH spelling is very irregular. It is hoped by many that the spelling reform will come upon us, but it is a very difficult matter to change the great number of words that they may be spelled as they sound. There are a few general rules that are of aid to us, but the best rule of all is to take down the dictionary and "dig." We submit, however, a number of the more familiar rules, together with examples governing them:

RULE 1.—A monosyllable, or a word accented on the last syllable, if it ends in a single consonant preceded by a single vowel, doubles the final consonant on the addition of a syllable beginning with a vowel; otherwise the final consonant is not doubled on the addition of a syllable.

RULE 2.—Words ending in *e* usually retain the *e* on the addition of a syllable beginning with a consonant.

RULE 3.—Words ending in silent *e* drop the final *e* on the addition of a syllable beginning with a vowel.

EXAMPLES.—hate, hating; write, writer; force, forcible.

RULE 4.—*y* preceded by a consonant is changed to *i* on the addition of a syllable not ending with *i*.

EXAMPLES.—agency, agencies; lazy, laziest; thirst, thirstier.

RULE 5.—English nouns form their plurals regularly by adding the syllable *es* to those singular forms which end in a hissing sound, and the letter *s* only to other singulars.

EXAMPLES.—fox, foxes; book, books.

RULE 6.—Nouns ending in *o* preceded by a vowel add *s* only, to form the plural.

EXAMPLES.—cuckoo, cuckoos; folio, folios.

RULE 7.—Common nouns ending in *y* preceded by a consonant form their plurals by changing the *y* to *i* and adding *es*.

EXAMPLES.—ally, allies; city, cities.

RULE 8.—Some nouns ending in *f* and *fe* change the *f* or *fe* to *ves* to form their plurals.

EXAMPLES.—beef, beeves; shelf, shelves.

RULE 9.—The principal element of a compound word is usually changed to form the plural, not the modifying element.

RULE 10.—Many foreign nouns now used in English retain their foreign plurals.

EXAMPLES.—alumnus, alumni; beau, beaux.

RULE 11.—Letters, figures and signs form their plurals by adding the apostrophe (') and *s*.

EXAMPLES.—e, e's; 6, 6's; x, x's.

RULE 12.—Some nouns have no singular, some have no plural, and some have the same form in both numbers.

EXAMPLES.—scissors (always plural); honesty (always singular); sheep (used in either number).

RULE 13.—Some nouns have two plurals of different meanings.

RULE 14.—A title used with two or more names should be put in the plural form.

EXAMPLE.—The Misses Smith, not the Miss Smiths.

RULE 15.—To write the possessive form of a noun in either number, write the nominative form in the singular or the plural as the case may be, add the apostrophe, and finally add *s* to all nouns in the singular and to all plurals not ending in *s*.

EXAMPLES.—boy, boy's, boys'; for goodness' sake, Brown & Gay's shoe shop; the queen of England's family.

CAPITAL LETTERS—WHEN TO USE THEM.

CAPITALS ....

1. Sentences.
2. Poetry.
3. Direct quotations.
4. Supreme Being.
5. Heaven.
6. Days of the week.
7. Names ....
    1. Of persons, also proper adjectives.
    2. Of places.
    3. Geographical.
    4. Of newspapers and magazines.
    5. Of organized bodies or societies.
    6. Of streets.
8. Initials. ....
    1. Names of persons.
    2. Literary titles.
9. Titles........................
    1. Official and honorary.
    2. Of books and essays.
10. Abbreviations.
11. United States; State; Territory.
12. East; West; North; South.
13. Important buildings and localities.
14. Pronoun I and interjection O.

RULES OF PUNCTUATION.

When there is no reason for the use of the point, never use one; in case of doubt use too few points rather than too many.

RULE 1.—Separate by commas (,) all the members of a series of words, phrases or clauses unless all are connected by conjunctions.

RULE 2.—Words used in pairs take a comma after each pair.

RULE 3.—Grammatically independent or parenthetical words, phrases or clauses are set off by commas.

RULE 4.—A phrase out of its natural order is set off by commas.

RULE 5.—A comma should be placed before a short quotation or any expression that resembles a quotation when it is introduced into a sentence without a formal introduction.

RULE 6.—Words, phrases or clauses, contrasted with each other or having a common relation to some preceding or following part of the sentence, are separated by commas.

RULE 7.—Even where no other rule seems to require them, commas should be used to indicate pauses in reading, without which the sense might be mistaken.

RULE 8.—The parts of a compound sentence, when short and closely connected, may be separated by the comma or not at all; but when they are not short or not so closely connected in sense, they are separated by the semicolon (;).

RULE 9.—When any one of the words as, namely, to wit, that is, for example, viz., i.e., e.g., and other similar expressions introduces an example, place a semicolon before it.

RULE 10.—The colon (:) is chiefly used after words formally introducing a quotation, speech, etc.

RULE 11.—Put a period (.) at the close of every complete and independent sentence which either affirms or denies. Put a period at the close of the title or description of a book on the title page; at the close of headings, subheads, sideheads, and date lines; after every abbreviation; after figures or letters used to number examples, remarks, divisions, etc.; and after letters expressing numbers by the Roman notation. Periods are also used as decimal points, as "leaders" to carry the eye along a blank line in tables of contents of books and other tabular work, and as marks of omission to denote that part of a quotation has been left out.

RULE 12.—Use the interrogation point (?) after every direct question.

RULE 13.—The exclamation point (!) is placed after any word, phrase or clause expressing strong or sudden feeling.

RULE 14.—Incidental words of exclamation, references, or any matter merely thrown into a sentence and not a necessary part of it should be enclosed within marks of parenthesis ( ).

RULE 15.—The dash (—) is used before and after a parenthetical part to indicate a greater degree of separation than that indicated by commas and less than that denoted by marks of parenthesis.

Rule 16.—The apostrophe (') is used to denote the omission of letters in contractions, in possessive case forms and in the plurals of letters, figures and signs, and in dates expressed by two figures only.

Rule 17.—The hyphen (-) is placed between the component parts of compound words.

Rule 18.—At the beginning of every direct primary quotation two inverted commas (") are placed, and two apostrophes (") are placed at the close.

Rule 19.—The caret (∧) is used in manuscript only, and indicates the place at which letters, words, or sentences which the writer has omitted by mistake or afterward desires to add, should be inserted. Make sure of the correct pronunciation of the word caret.

Rule 20.—The dieresis (¨) is used over the second of two adjacent vowels to indicate that they are to be pronounced in separate syllables, the latter not joining with the first to form a digraph or a diphthong.

Rule 21.—Marks of reference—the asterisk (*), the dagger (†), the double dagger (‡), the section (§), the parallel (‖), and the paragraph (¶)—are used in the body of the page in the order named to call attention to notes at the bottom or in the margin indicated by the same respective marks and referring to the words or sentences by which the marks in the body of the page are placed. When more than six footnotes or marginal notes are placed on one page the seventh mark of reference is the double asterisk (* *) and all the other marks are likewise doubled in turn to refer to further notes. Instead of these old marks of reference, figures or letters are sometimes used, placed just above and to the right of words to which the notes refer in what is called "superior" form, as, [1], [2], [3], etc., or [a], [b], [c], etc. Sometimes they are placed within marks of parenthesis just after the words to which the notes refer, as (1), (2), (3), etc.

Rule 22.—Ditto marks (") are used to indicate the repetition of words used in the line just above without printing or writing them again.

RATES OF POSTAGE AND CLASSIFICATION.

First Class.—Letters (hand and typewritten, and letter press, or manifold copies of either) and sealed packages are two cents each ounce or fraction thereof, with no limit to weight.

Second Class.—Newspapers, periodicals entered as second class matter, and sent by the publisher or news agent, are one cent per pound, with no limit to weight. Same when mailed by others than above, are one cent each four ounces or fraction, with no limit to weight.

Third Class.—Books, circulars, pamphlets, and other matter wholly in print, proofsheets, corrected proofsheets and manuscript copy accompanying same, facsimile copies of hand or typewriting obtained by a mechanical process and easy of recognition as imitations, when mailed in twenty or more, separately addressed, identical copies, at a postoffice or station (when mailed otherwise or in less number, such matter becomes subject to first class postage), one cent each two ounces or fraction thereof, with weight limit at four pounds, except single books weighing in excess of that amount.

FOURTH CLASS.—Merchandise and matter not included in any of the above classes, are one cent each ounce or fraction thereof, with weight limit at four pounds.

The postage rates and conditions to Alaska, Cuba, Hawaii, Guam, Porto Rico, the Philippines and the Island of Tutuila are domestic in every particular.

REGISTERED MAIL.

Domestic.

Fee, eight cents per letter or package. Postage additional.

All classes of mailable matter may be registered. Matter addressed to fictitious names, to initials, to box numbers simply, or to vague and indefinite addresses, cannot be registered. The fee on registered matter, domestic and foreign, is eight cents on each letter or parcel in addition to the postage, both to be fully prepaid with ordinary postage stamps Two or more letters or parcels addressed to, or intended for, the same person cannot be tied or otherwise fastened together and registered as one. Matter for registration should be legibly and correctly addressed, with the address of the sender written in the upper left-hand corner. First class registered matter should be placed in a stout envelope or wrapper and securely sealed. Postmasters or postal employes are forbidden to address registered matter, place the contents in an envelope, seal it, or affix the stamps. These things should be done before such matter is presented for registration. Third and fourth class matter for registration should be so wrapped as to safely bear transportation, and easily admit of examination. Registered matter will only be delivered to the addressee in person or upon a written order, and its delivery may be limited to addressee exclusively by special direction in writing upon the envelope.

Persons calling for registered mail should be prepared to furnish reasonable proof of their identity, it being impossible otherwise to guard against fraud.

A return receipt signed by addressee, showing delivery, is mailed to the sender of each domestic registered letter or parcel, for which service there is no extra charge.

Foreign.

Any article of mailable matter addressed to a foreign destination may be registered, provided that the postage thereon be fully prepaid in addition to the registration fee, which is eight cents by postage stamps affixed.

MONEY ORDERS.

No single money order will be issued for more than $100. When more money is to be sent additional orders must be secured. Upon application a printed form will be handed to the remitter on which will be found blank spaces for the number of dollars and cents, whom sent to, name of town or city, street and number, and State, also by whom sent, and address.

MONEY ORDER FEES.

The following are the fees charged for domestic money orders in the United Stat(which includes Hawaii and Porto Rico), in Canada, in Cubá, and in the Philippines:

For orders for sums not exceeding				$ 2.50	3 cents
For over	$ 2.50	and not	"	5.00	5 "
"	" 5.00	"	"	10.00	8 "
"	" 10.00	"	"	20.00	10 "
"	" 20.00	"	"	30.00	12 "
"	" 30.00	"	"	40.00	15 "
"	" 40.00	"	"	50.00	18 "
"	" 50.00	"	"	60.00	20 "
"	" 60.00	"	"	75.00	25 "
"	" 75.00	"	"	100.00	30 "

Special attention is directed to the fact that domestic money orders are now used i business with Canada, Cuba and the Philippines, and the domestic fees only are charged.

..A COMPLETE SCHOOL OF PENMANSHIP AT HOME...

CEDAR RAPIDS, IOWA

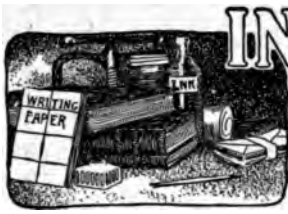
A Self-Teaching Series of Lessons in Rapid Muscular-Movement Writing. Especially adapted for Home Study and for use in all classes of schools where the utilitarian is made the basis of instruction. ❧ ❧ ❧ ❧ ❧ Satisfactory Results have never failed to follow its adoption and use. ❧ ❧ ❧ ❧ ❧ ❧

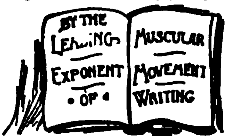
Dedication

To the teachers of America, who believe in the development of free movement as the foundation for sensible writing, this little book is dedicated.

The Author.

SELF INSTRUCTION IN MODERN WRITING





MUSCULAR MOVEMENT—ITS DEVELOPMENT AND APPLICATION.

By A. N. PALMER,

Author of the Palmer Method of Business Writing and Editor of the *Western Penman*.

I HAVE thought best to evade the historical, the obsolete and non-practical part of chirography, and deal only with the live, up-to-date, utilitarian phases of writing, the issues that will appeal directly to young men and women who seek training that will fit them for the practical business life, where rapid, legible penmanship is even more in demand than before the advent of the typewriter and the art of shorthand.

Shorthand and typewriting may have supplanted longhand writing in some directions, but they have emphasized the necessity of legibility and speed in other directions.

The Value of Good Penmanship.

The man who hires a stenographer will pay a higher salary to one who can write a good business style of longhand than he will pay to one who simply scribbles, and the reason is self-evident. In very few offices are stenographers relieved from all writing of longhand. Records are to be kept, addressing and many other things about a well-managed office are done, which can be more conveniently done with pen and ink than with the typewriter.

No young man or woman, regardless of the vocation chosen, will regret the short time necessary to spend in mastering a good style of business writing. Under modern methods the process is not only short, but it is easy, and to the majority a delightful pastime.

New System Improvement upon the Old.

Under the old regime we might fittingly exclaim with Will Carleton:

Oh, pen, when in tne old time school-house we
Strove, 'neath our teacher's rod, to master thee,
And twisting down upon some sad old desk,
With doleful air and attitude grotesque,
And with protruding tongue and beating heart
Took our first lesson in the graphic art,
And that old copy on the paper poured,
Saying, "The pen is mightier than the sword,"
And then from sudden and dynamic stroke,
The pen we leaned on into fragments broke,
Some angel told our inexperienced youth,
That, after all, that copy told the truth.

That was when everything in penmanship instruction tended toward one end only, accuracy; accuracy without ease, and accuracy without speed, a slow drawing style in which the fingers were the chief, if not the sole, agents of execution. This, the copybook plan, still quite largely in use in public schools, developed a style of penmanship that was good only when the execution was slow, and when but little writing was required. The outcome, in fact, was a retrogressive tendency as soon as an attempt was made to apply speed, and when continuous writing was demanded.

The copybook mode of instruction has always led to poor, rapid continuous writing; indeed, I might say, to scribbling. In fact, any plan of penmanship instruction in which the large tireless muscles of the arm are ignored can lead to only one end—poor, erratic writing, and perhaps writer's cramp when much and continuous writing is required.

The Successful Plan.

The student who desires to master a good commercial style of penmanship in the shortest possible time, should give careful attention to the cultivation of the muscles of the arm, and the movement from these muscles. Muscular movement should receive more attention on the start than the forms of letters.

Latent in the arm of every boy and girl and man and woman of whatever age, providing the faculties are well preserved, is an easy, free movement that may be developed and applied to good writing within an almost incredibly short time if the right methods of training are followed.

The successful plan is to study the muscles of the writing arm closely, gaining some control of them and ascertaining their functions before attempting to do much writing, or any good writing. Good writing—the result of good movement and muscular control—will closely follow.

Writing Materials.

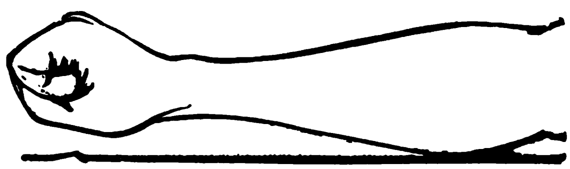
Do not attempt to practice penmanship with poor paper, poor pens, or poor ink. Good material is an absolute necessity. Do not use a metal finished penholder. A rubber finished "Crown" and cork finished "Bank" are among the best penholders made. Never use an oblique penholder in business writing. It is out of place and of no advantage whatever. There is nothing that equals an oblique holder for ornamental writing, but there its utility ends. Use paper of generous size for your practice, a medium coarse pen and good blue-black writing fluid.

Clothing for the Right Forearm.

As the movement taught is one in which the muscles of the right forearm play an important part, it is highly essential that these muscles should be so clothed as to permit, at all times, unrestricted action. Many good writers consider this of sufficient importance to lead them to cut off the right undersleeve at the elbow.

Definition of Movement.

The muscular movement, as applied to writing, is the movement of the muscles of the arm from the shoulder to the wrist, while keeping the larger part of the arm forward of the elbow on the desk, the fingers not being held rigidly, but remaining passive, and not being extended or contracted in the formation of any of the capitals or any of the small letters except the upper loops, when there may be a slight extension and contraction in making the turn at the top. In this movement the propelling power is located behind the elbow in the upper muscles of the arm.



Examine your right arm. Notice the increasing size from the wrist to the elbow. Grasp the right arm with the left hand just below, but near the elbow. Note particularly the elasticity of the muscles; move the flesh on the right arm forward and backward with the left hand. On the development of the elasticity of that muscle depends your success in learning a good style of business writing. You are urged to read the above a number of times. It is important.

How to Develop Muscular Action.

Throw your right arm on the desk and close the fingers of the right hand tight (see accompanying cut). See how far you can move the hand forward and backward without slipping the sleeve or without any motion of the wrist or fingers. The fingers must be closed so that you cannot extend or contract them.

No. 1. Finger Study.

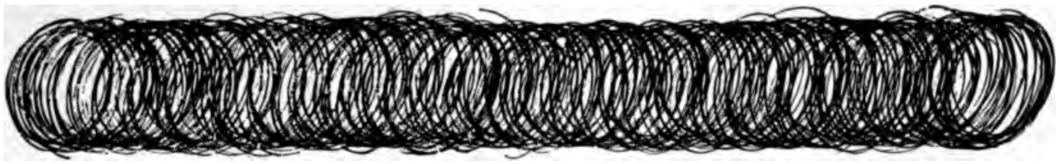
No. 2. Finger and Relative Position Study.

The purpose of illustrations 1 and 2 is to show the natural positions of the fingers that should be maintained in writing. Throw your arms on the desk in a natural position, such as you would take if you were simply resting and not contemplating using a pen; turn the palms of the hands upward, as shown in cut 1, and study the position of the fingers. Now turn the palms downward and raise both arms from the table, as shown in cut 2, the left hand being a little in advance of the right; drop both arms to the table and you will be in a good writing position. But let us go further.

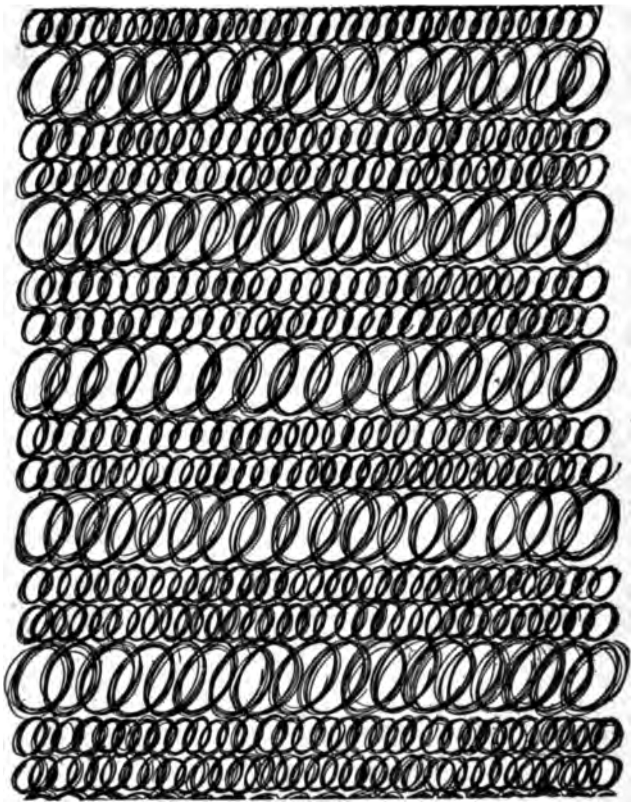
Study closely the position of the right hand in illustration 3. Note the fact that the fingers have not been changed from numbers 1 and 2 beyond what was necessary to hold the penholder firmly. The penholder rests against the side of the second finger, at the root of the nail; the first finger rests on the upper part of the holder, and the thumb rests against the side of the holder at the lower joint of the first finger. Notice further the relative position of every part of the holder with the hand. Now pass on to illustration 4. Here we have a good position for executing writing rapidly and easily on the regular slant. The right arm is thrown well out from the side and a right angle (turn) is formed at the elbow; the third and fourth fingers are thrown well under the hand, forming a movable rest; the side of the hand and wrist, while near the paper, does not touch it; the penholder points a little to the right of the right shoulder; the left hand is at the upper left corner of the paper, keeping it in position; the body, while bending slightly at the hips, is self-supporting, and the large muscles of the forearm rest on the desk, the fulcrum or main rest being just forward of the elbow. Before going any further, experiment with position. Move the hand forward and backward, right and left, round and round, without extending or contracting the fingers holding the pen, and with the pen raised from the paper.

No. 3. Natural Position of Penholder.

No. 4. Natural Position of Hand.



DRILL 1.



DRILL 2.

Here are given drills that should be practiced by beginners in muscular movement a few minutes at the beginning of each writing period during several weeks, or until the movement becomes light and elastic and a fair measure of control has been acquired.

A movement drill is a repeated form, and it may be a letter or a part of a letter, but it should be so simple in construction and susceptible of such ease in execution that the mind is relieved from the tedium of constantly dwelling upon the forms, and can be given to movement study.

In number 1 the movement used is in the direction of the capital O, and in order to make the oval very compact all strokes should be very light. One method used in making very compact ovals, is to first carry the ovals across the page with somewhat open spacing and go over the same path again and again, until all white paper disappears. Through this process the fiber of the paper is not picked up by the point of the pen, and the final result is much more pleasing than it otherwise could be.

In number 1 not less than 185 downward strokes should be made in a minute, and the same rate of speed should be applied in number 2.

Counting to Regulate Motion.

In developing light, uniform motion in class penmanship practice, counting is an important factor. It makes the work more interesting than it would otherwise be, tones down the movement of the naturally nervous pupils, acts as a constant spur to the habitually slow boy or girl, and keeps the indolent student busy. In the oval exercises given in drill 1 the down-

ward strokes only should be counted. The other parts of the drill being what are termed connective lines are not counted. In the traced ovals, drill 2, the count should be 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 for each completed oval.

Preparatory Motion.

Read the following carefully until thoroughly understood. It is of especial value to beginners. Before making the oval drill or attempting any part of it, move the pen in the air and move it rapidly over the path of the oval a number of times. While doing this, watch closely the movement of the muscles of the arm, studying the motion and its application. While the pen is moving rapidly, and without checking its motion, let it strike the paper. The force thus gathered will compel light, quick action, will break up finger motion, will give smooth lines, and will aid form building.

CAUTION.—Before attempting the large oval drill, be sure that all the conditions are favorable. Not much can be accomplished unless the rules in regard to position of body, arm, wrist and fingers are closely observed. Reread the beginning lesson if necessary. Do not waste time by attempting to do something you do not understand. Work intelligently and satisfactory results are sure to follow.

The author's constant admonition to beginners is to give more attention to the action of the muscles of the arm on the start than to the forms; overcome muscular rigidity; make muscular relaxation a habit; experiment frequently in movement practice with nothing in the hand or without touching the pen to the paper. In a word, gain muscular freedom and muscular control and the mastery of the form of the letters will be easy, and a good permanent style of rapid writing will be the outcome.

DRILL 3.

Drill 3 is what we term a forcing movement drill, and it is one of the best for the beginner to practice.

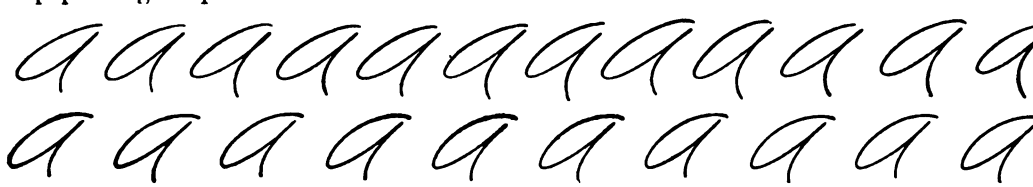
In the direct traced oval make six revolutions in a count of 1, 2, 3, 4, 5, 6, lifting the pen on the base line on the sixth count without checking the motion, swinging it in the air to the beginning stroke of capital A. Thus the student will be forced from a slow, lagging movement to a motion that is elastic and rapid. The form may not be entirely satisfactory at first, but it will improve rapidly if this process is continued a reasonable length of time and repeated at frequent intervals.

The rate of speed should be about twenty complete traced ovals and as many capitals to the minute.

The propelling power is located behind the elbow. Do not forget this, and do not think of the energy and force as coming from the hand, fingers or wrist.

Following the plan suggested in connection with drill 3, the rotary motion should be applied in drill 4 below, the pen being in motion when striking the paper and in motion when leaving it. From seventy-five to eighty-five good capital A's should be made to the minute.

AN IMPORTANT SUGGESTION.—Hold the practice paper in position with the left hand and always keep the paper in about the same relative position to the right arm. Move the paper from right to left and from left to right with the left hand, as may be required to keep the paper in good position.



DRILL 4.

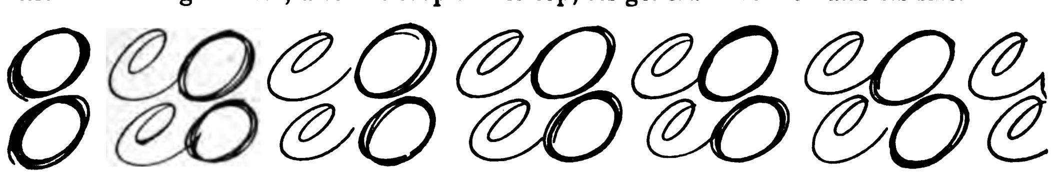
DRILL 5.

The method of practice in drill 5 should be the same as in capital A, drill 3. After each traced oval lift the pen while in motion, swinging it below the base line and around to the beginning point of the capital O without checking the motion. Drive the pen rapidly, and bring the muscles of the arm into active play. First make ten revolutions for the traced oval, gradually decreasing the number to six; count six for the ovals and count two for each capital O.

DRILL 6.

Not less than seventy of this form of capital O should be made in a minute.

This capital O is very popular with many excellent business penmen and teachers of modern writing. Study the letter and make a mental photograph of it. Note particularly the curves of the left and right sides, also the loop at the top, its general direction and its size.

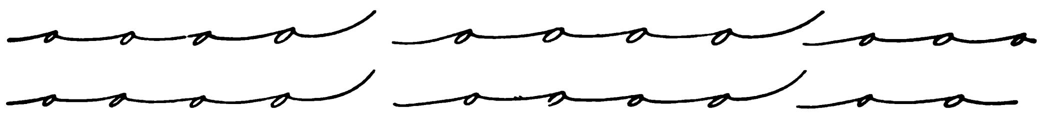


DRILL 7.

The plan of practice for drill 7 is the same as for drill 3 and drill 5.

DRILL 8.

Lift the pen from the paper while in motion in finishing a capital; continue the motion with the pen in the air and bring the pen to the paper to begin the next capital—all without checking the motion. Make about seventy letters to the minute.



DRILL 9.

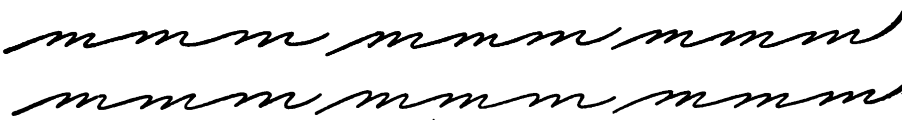
So far in the lessons the direct oval and some of its applications have been almost exclusively given as drills. In the connected small o just as much freedom of motion is necessary, but its operation should be in almost a straight line toward the right, thus developing the application of lateral movement used in such small letters as m, n, o, u, w.

The small o drill above should be practiced a few minutes every day during at least the first three months of a course in muscular movement writing. It can be made a very interesting drill.

In connection with this drill we urge teachers who have never tried the plan to use what we might term a conversational count. Walk about the room in time to the count of the letter, and in passing from desk to desk criticize the work being done by students in the same rhythm. Supposing that passing down an aisle one student is making the o too large, another is not closing it at the top, another is using a slow, dragging movement, another is making a narrow, flat letter, and still another is bending over the desk too far, the criticisms would be as follows: Make 'em smaller, make 'em smaller; close 'em up, close 'em up; slide along, slide along; round 'em out, round 'em out; sit up, sit up. Each criticism or admonition may be repeated until the error has in a measure been corrected. The influence will not be lost upon the rest of the pupils, but those who have been making the same errors will, almost unconsciously, show a marked improvement. Home students who are endeavoring to master a good style of writing without the aid of a teacher may use the same plan in counting as they practice.

Make page after page of the connected small o. Keep it up until you can make, with an easy, sliding movement, and nearly as well as the copy, more than one hundred to the minute. That is by no means fast, but while permitting good form it is fast enough to force light movement.

To save paper, the small o may be made on the lines, between the lines, and across the lines. The plan of writing across the lines is greatly to be commended and encouraged as tending to develop lightness and freedom of movement.



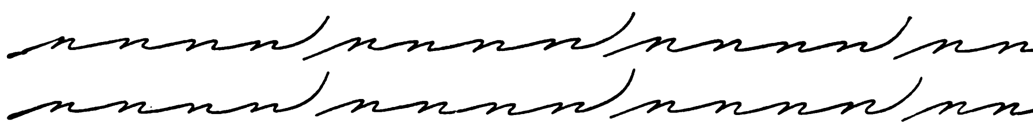
DRILL 10.

Preparatory to practice on drill 10, test the movement by moving the pen in the air in the direction of the first stroke. Start the motion below the base line, and as the pen moves rapidly upward let it strike the paper at the beginning point. Drive the pen through the exercise rapidly and lightly. Do not make less than three connected m's before lifting the pen, and make more as soon as you have ability to make them well. You will make the letters too large, irregular and awkward at first, and you will have trouble with the union (connecting lines), but never mind, keep right on. All is well that ends well, and you will succeed if you persevere.

Not less than twenty completed exercises, or sixty small m's should be made to the minute.

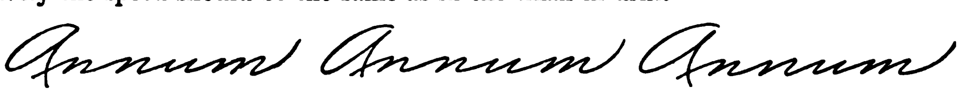
Bear in mind that an under stroke follows each m, the m proper being made with an over stroke.

Count 1, 2, 3, 1, 2, 3, 1, 2, 3, or 1, 2, 3, 4, 5, 6, 7, 8, 9.



DRILL 11.

For small m a count of three is used, and in the n a count of two; thus the count for drill 11 will be 1, 2, 1, 2, 1, 2, 1, 2, etc. Or for four connected letters, 1, 2, 3, 4, 5, 6, 7, 8. Relatively the speed should be the same as in the small m drill.



DRILL 12.

Here is our first word drill. *Take care of the movement and the letters will take care of themselves. Do not neglect the study of the motion and its application to the form to be made.* Write the word Annum at the rate of sixteen or more words to a minute.

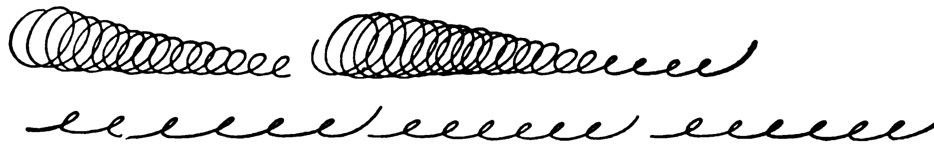
DRILL 13.

Write the word Common at the rate of about eighteen to the minute.

DRILL 14.

It is expected that these word drills will be treated as movement exercises, and that the repetition of each word until a page or more has been written will not only bring about a

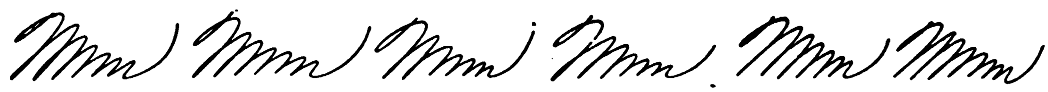
marked improvement in the appearance of the writing but will also improve muscular action. Do not neglect to give attention to the muscles of the arm.



DRILL 15.

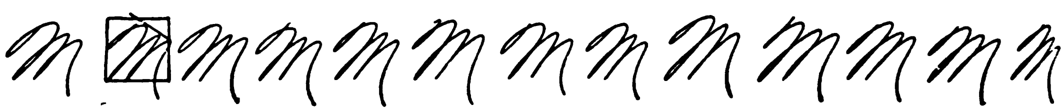
Drill 15 may be used in developing small l and corresponding loops of small b, h, k, and f, as well as small e. The object of the oval as a preparatory drill is twofold: First, to force the hand to move lightly and quickly, and second, to lead the motion in the direction of the letter itself. This is a good drill to practice often.

Capital M is a letter that affords splendid opportunity for the development of movement, and drill 16 leads up to it. For this drill count 1, 2, 3, 4, 5, 6, 7, and make twenty-five of the complete drills to the minute. Compare your work with the copy.



DRILL 16.

Study the capital M closely before trying to make it. Compare the parts in their relation as regards height, slant and width. Make about forty letters to the minute, and count 1, 2, 3, 4 for each letter.



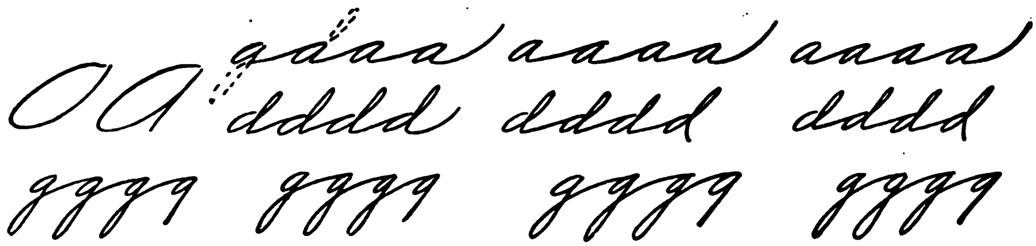
DRILL 17.

DRILL 18.

In the capital M a count of four is used. There is one count less in the capital N. In practice work from fifty to sixty of these letters should be made to the minute. No special effort should be made to form a loop at the junction of the first and last parts of capital N. Let that part of the letter take care of itself, but in size and general proportions the copy given should be closely imitated.

Remember that, with a slow, dragging or cramped movement, nothing of lasting value can be accomplished in penmanship development.

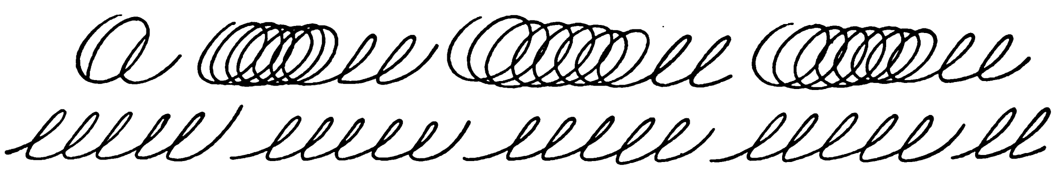
It would be well for the learner to practice on easy words at this stage of the work, following the plan of drills 12, 13 and 14. It may be well to connect the last part of each capital with the small letter following as soon as uniform movement can be applied to the capitals as given in drills 17 and 18.



DRILL 19.

The small a is, in the main, a reduced copy of the capital A, and the first parts of small d and g are identical with small a. Fix the resemblance in the mind; it will help you. In business writing it is best to make the looped small d. It is just as legible and much faster than the stem. The loop to small g should be made without finger motion. We favor the blunt style in small g and y when they are final letters in a word. The small g thus made is identical with the figure 9.

Practice each letter in groups until a decided improvement is seen. Practice speed—from seventy to eighty good a's and about sixty of small d and g to the minute.

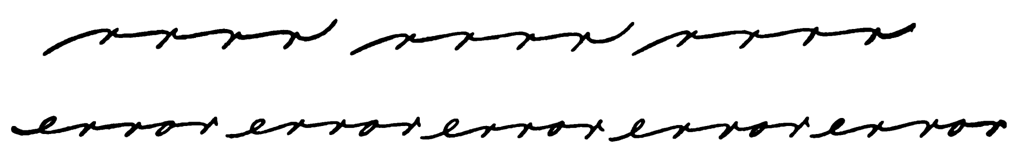


DRILL 20.

Study the relation of the loop to the oval, as shown in the first line of drill 20.

The letters given here are of about the right length for average business writing. There is a slight checking of the motion on the downward strokes, but not enough to stop the motion at the base line. After a little practice loops as good as the above in groups of five should be made at the rate of from 125 to 150 to the minute.

The Spencerian forms of small letters have been mainly followed in the copies given, departures being made only when more abbreviated or rapid forms seemed essential. In small r and p following, forms are given that are mainly used by the best business penmen, because of the rapidity with which they can be made.



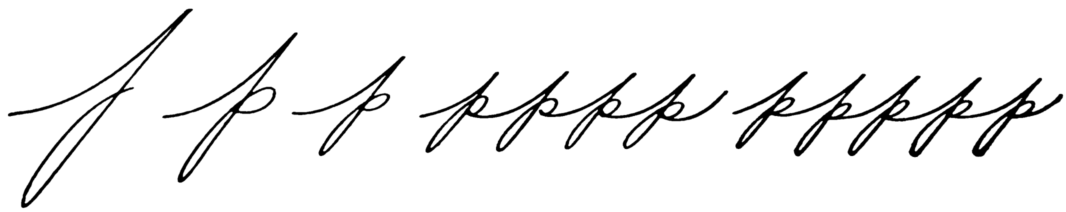
DRILL 21.

The first stroke in small r, above given, is very much like the first part of small m or n. The downward stroke is retraced to a point about one-fourth of a space above the first part; a stop (hardly noticeable) and a dot are made before the swinging curve to the next letter.

Close study of the form while practicing will be necessary. After its mastery, one hundred connected letters to the minute will be a good rate of speed. The first few trials will unquestionably be discouraging, but faithful practice will be rewarded. Stick to it.

Practice speed in the word error, from twenty to twenty-four words to a minute.

CAUTION TO THE STUDENT.—Never begin to practice until you are sure you know how to practice. Languid, thoughtless practice should be avoided. Put ambition, put energy, put the fire of determined will behind your practice, and the results will be astonishing. Take advantage of all favorable conditions. Keep not only the muscles of the right arm in a relaxed condition, but guard against tense muscles in any part of the body. Keep the side of the hand and the wrist free from the desk; keep the right arm well out from the side; keep the right hand in front of the eyes; keep a right angle at the right elbow, and remember that the propelling power is located back of the right elbow. If you think you are in a good position for writing, test the movement without touching the pen to the paper, and while doing this, study the conditions under which you are trying to work. Be sure you are right before you go ahead.



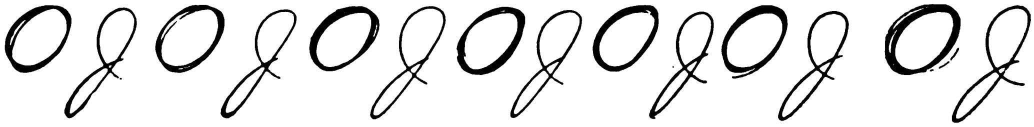
DRILL 22.

In the above is given a particularly excellent drill, to be made with pure muscular movement.

From sixty to sixty-six connected letters should be made to the minute. Make frequent comparisons and write a page.

Reverse Oval and Application.

An application of the reverse oval motion is made in forming the capital J. Study number 23. The reverse oval, it must be understood begins with an upward stroke on the left side. Before attempting the capital J make reverse ovals four or five minutes, and if the movement is then light and uniform, this copy may be safely practiced. The oval, in connection with capital J, is used as a driving force.



DRILL 23.

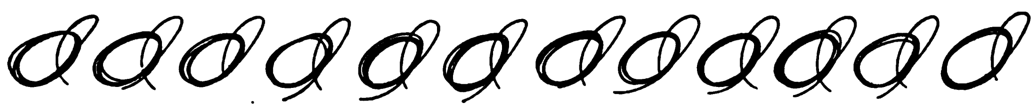
Make the oval in a count of six, lift the pen from the paper at the top, and without checking the motion, swing the pen in its natural course in the air to the right and below the

base to the point of contact with the paper in starting the letter. Do not stop the motion, but strike the paper in an upward course at full speed for the beginning stroke of J. If the explanation of applied motion is not fully understood, study it until it is, and then fill at least a half page with the copy.

Do not neglect the form, but note carefully the following points: The J should begin with an upward stroke from a point just below the base line; the turn at the top should be round; the upper part should be about one space longer and twice the width of the lower part.

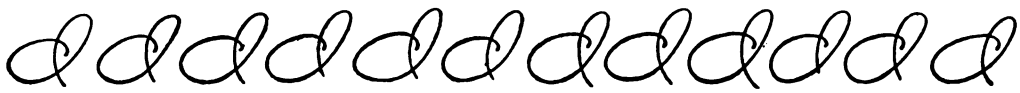
DRILL 24.

This copy is given as a drill on both movement and form. From the beginning stroke of J to the finishing stroke of s the pen should not be lifted. Write the word from beginning to end with a steady, light and uniform movement. Eighteen or twenty words to the minute will be a fair rate of practice speed.



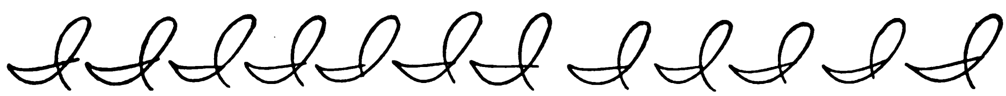
DRILL 25.

The count for this drill is 1, 2, 3, 4, 5, 6, 7, 8; two for the capital I and six for the oval drill. Capital I begins in same manner as capital J, but the upper part is narrower. Write fifteen or twenty lines of this copy before passing to the next.



DRILL 26.

Not less than fifty of this capital to the minute. The count is two for each letter.



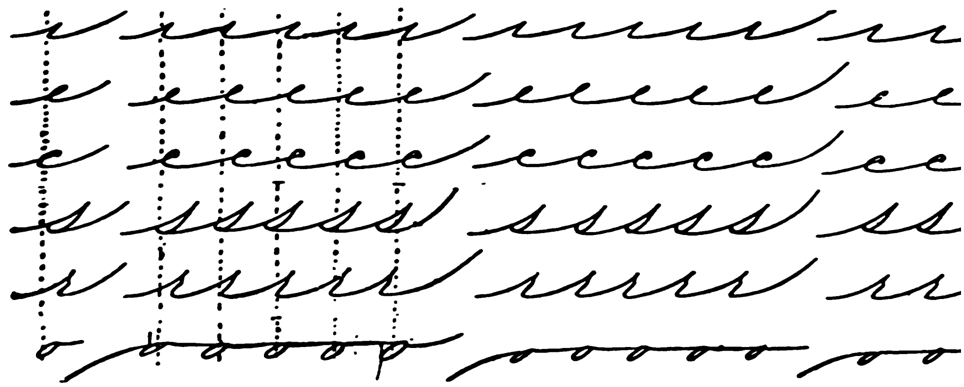
DRILL 27.

The angular finish in this letter is of especial value when small letters follow, as shown in the following line:

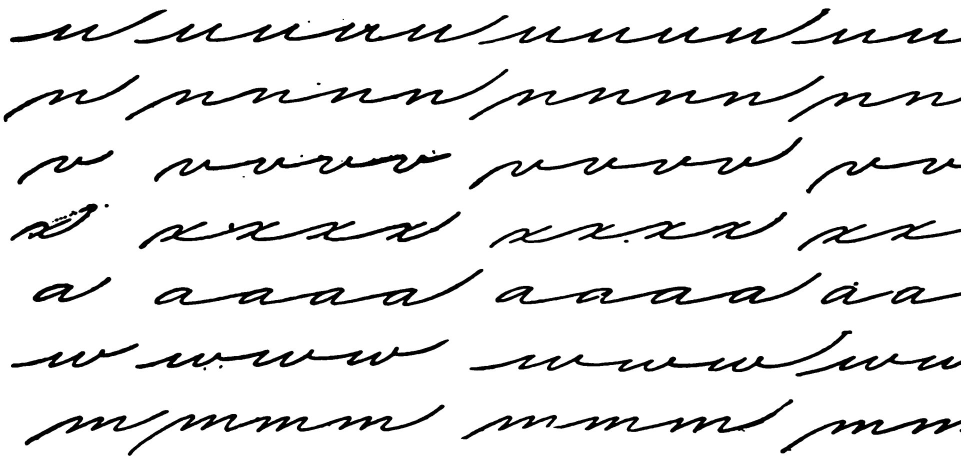
DRILL 28.

This is a medium hand, but it is often necessary to write more compactly. Other words in which the small letters already practiced are used, may be introduced for practice.

One Space Letter Drills.

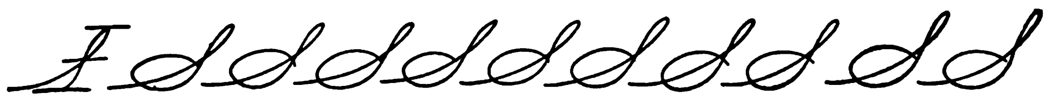


DRILL 29.



DRILL 30.

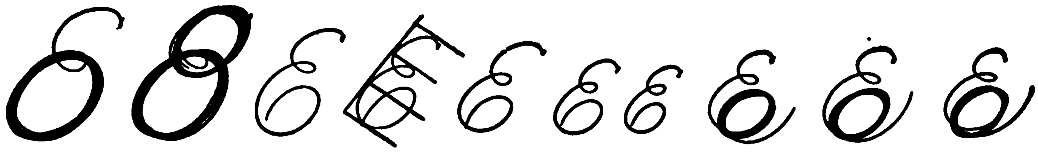
Enough attention has now been given to movement development, movement app



DRILL 32.

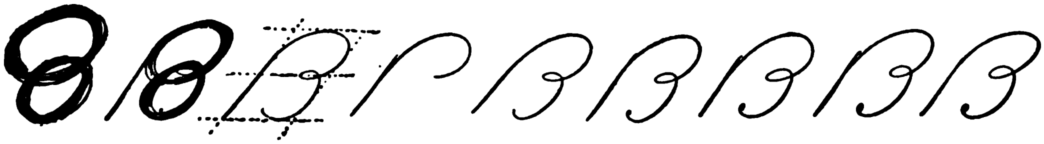
DRILL 33.

DRILL 34.



DRILL 35.

DRILL 36.



DRILL 37.

Definiteness is essential in business writing. There should be a definite starting point and a definite ending point in every letter. Every curve and every loop should be definite and have a definite place in the process of construction. In studying the forms of the letters here given, bear this in mind. Capital B may end in a dot, as shown in the greater number of the letters given above, and it may end in an angular turn, furnishing a connective stroke for the letters following.

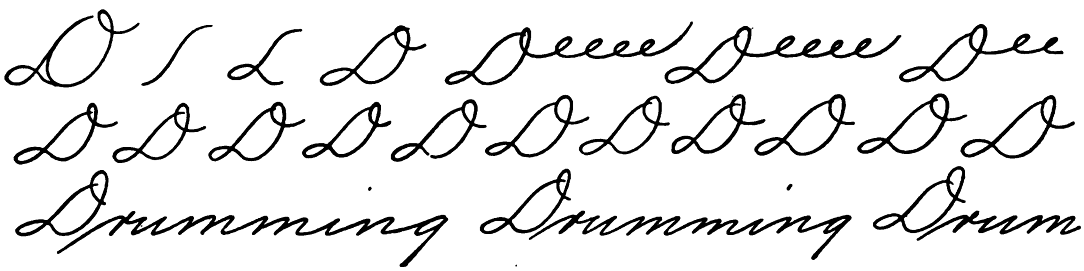
The count for capital B is 1, 2, 3, and a fair practice speed is fifty to the minute.

To Relieve Muscular Tension.

It is often an advantage to go over the path of the letters or exercises with the pen in the air. This method is especially helpful to a student whose muscles are hard and who finds difficulty in overcoming the tendency to keep the muscles of the arm and body in a rigid condition. This plan has been suggested in former paragraphs, and we consider it of sufficient importance to receive emphasis here.

Another plan which the author has recently found helpful to students who write with strained muscles, is to place a paperweight on the paper, and write with the left arm hanging at the side. Under this plan the tension on the right arm is relieved at once.

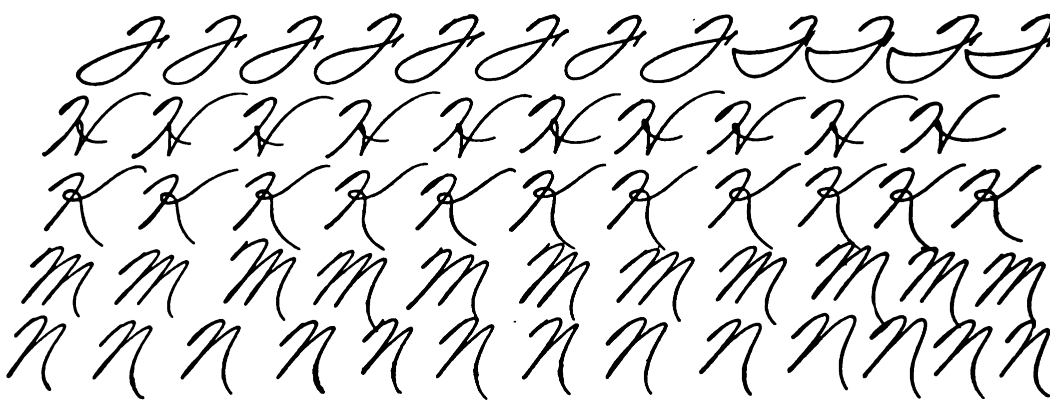
Still another plan to relieve this tension so common among beginners, is to select some easy drill like small o or m, and make it across the lines of the paper while keeping the eyes fixed upon some object at a distance and on a level with the eyes when the body is fairly erect.



DRILL 38.

In twelve of the business capitals we have the fish-hook, or small loop beginning. Most pupils find this style of starting the capital letters somewhat difficult at first, but when fully mastered it becomes a favorite. It is of sufficient importance to be given considerable study and practice.

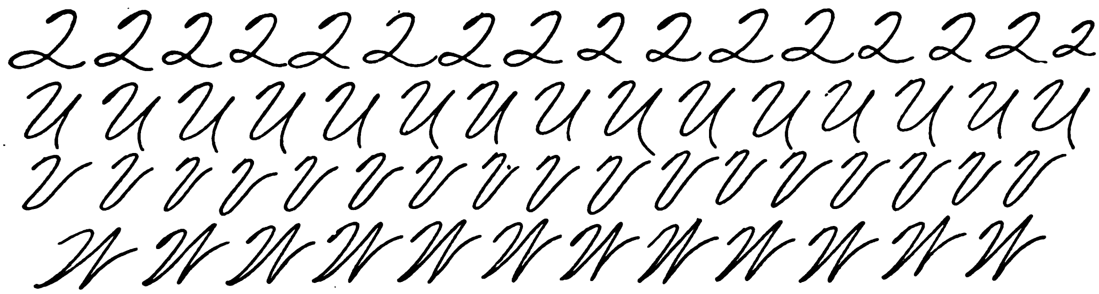
A careful study and comparison of these capitals will show that in F, Q, W, X, and Z the main downward strokes are curved much more than in H, K, M, and N, while in U, V, and Y compound curves are used in these main strokes.



DRILLS 39 TO 43.

Work faithfully on every letter. Repeat the form of each letter over and over until decided improvement can be seen. Make frequent comparisons. Study length, breadth, curves and connections closely.

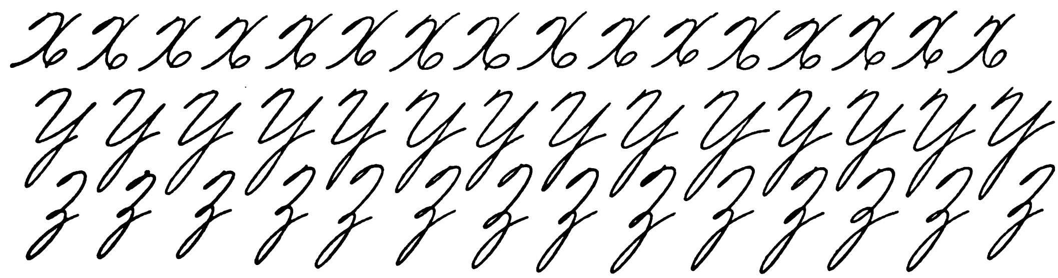
Rate of practice speed to the minute, F, sixty; H, thirty-five to forty; M, forty-five to fifty-five; N, sixty.



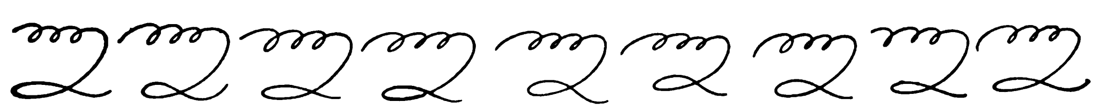
DRILLS 44 TO 47.

Rate of practice speed, Q, thirty-seven; U, fifty-six; V, sixty-eight; W, forty-four to the minute.

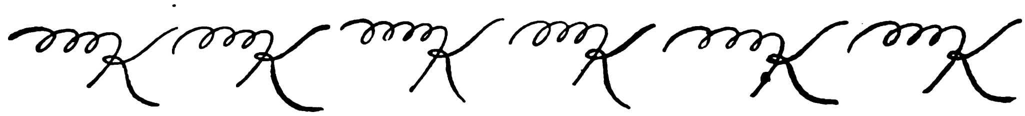
POINTS TO OBSERVE.—Capital Q is the enlarged form of the figure 2. The last parts of capitals U, V, and W are shorter than the other parts, and the first main strokes in U and V are exactly alike. In making capital W check the motion a little at the base line in the first main downward stroke, as this will aid in the construction of the first part.



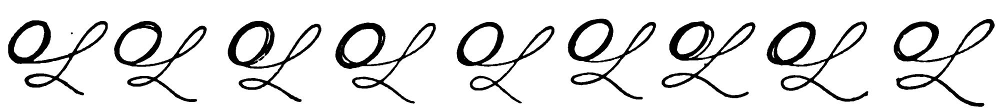
DRILLS 48 TO 50.



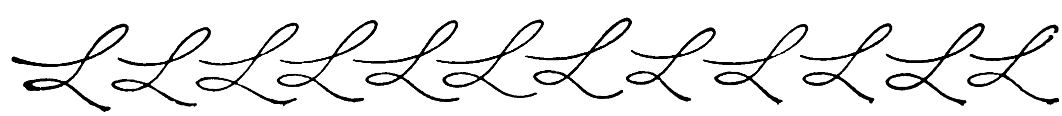
DRILL 51.



DRILL 52.



DRILL 53.



DRILL 54.

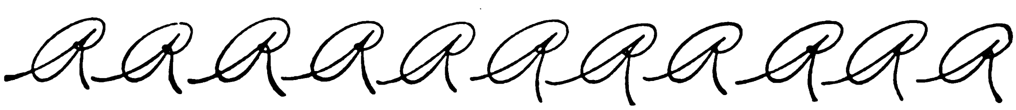
See how lightly you can carry the pen over the paper. Barely let the points of the pen touch it. Make a test of the movement with the pen above the paper, and when fully ready for action make from sixty to seventy good letters to the minute.

DRILL 55.

Do not make the beginning part too high; it should be but little more than two-thirds the entire height of the letter. Note particularly that the last part curves over the top of the main (first) part without touching it. Time and hard work will be important factors in developing this letter. Be earnest, be faithful. The count is 1, 2, 3, 4, and about forty-five letters should be made to the minute.

DRILL 56.

Make a few letters in the air as a preliminary movement drill before beginning active work. As will be readily seen, nearly all the main oval part is at the left of the beginning stroke. The count is two, and from fifty to sixty letters should be made to the minute. Make a full page and practice steadily, not spasmodically.



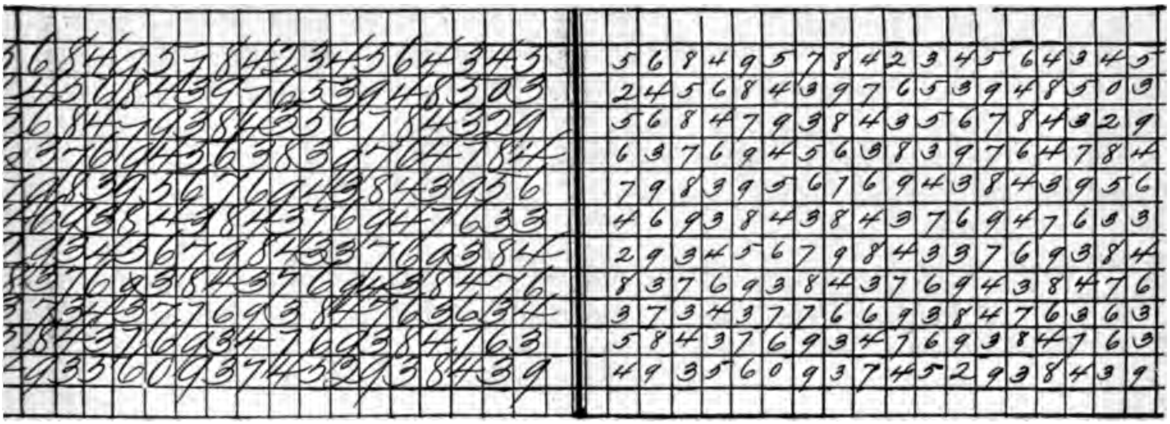
DRILL 57.

This letter is a good movement drill. Count three, and be sure to connect the last part with the first, in a loop a little above the center of the letter. From forty-five to fifty good letters should be made to the minute.

Business Figures.

Nothing within the range of business writing is more important to the average bookkeeper or office clerk than good figures. In many lines of accounting thousands of business figures are made without the writing of a single word.

This, in a measure, is true in many branches of statistical work connected with railroad bookkeeping where headings are printed and page after page is filled with figures. The first requisite is legibility, and its importance cannot be emphasized too much. While, in writing the letters in a word, each may be known by the context, in making figures, each must depend upon itself for legibility. How important then that each figure should be so formed that its value, in a group or by itself, cannot be mistaken.



FOR STUDY. FOR PRACTICE.

Figures should be made small. Students sometimes think that large figures are necessarily the plainest, but such is not the case. Examine carefully the diagram presented herewith. At the left are figures that are absolutely plain; one could not be mistaken for another, and yet their extreme size in the space in which they are placed make them difficult to read. At the right are the same figures, made no better, but a great deal smaller. Please note carefully the fact that these, surrounded as they are by white paper, and much smaller, are much more legible, even at a distance, than are the large figures at the left.

Students who have practiced in copybooks have almost invariably acquired the habit of making figures three or four times too large. Those that we present for models from which to practice are large enough for ordinary use. If occasion demands, it will be easy to make the figures larger. One-eighth of an inch is perhaps high enough for ordinary figures, while in some places it would be advantageous to make them even smaller.

Form.

Naught, a disconnected small o, always closed at the top; one, a plain oblique straight line; two, a small loop or a dot in beginning, a full right curve to base, and a small loop flat on base; three, beginning with dot, upper part about one-third entire size, made with a great deal of side motion; four, oblique straight line, horizontal straight line finished with a slight left curve extending a little above the first part and resting on the base line; five, beginning with plain downward oblique line, well rounded in main part, and with the horizontal line at top always connected with first part; six may extend above the other figures, and should always be finished with a small loop, the finishing point being brought to base line each time. There are no angles in the form of seven given here. A more graceful form could have been produced had two angular turns been made, one at extreme upper left and other at extreme upper right point, but such a form sacrifices speed while gaining nothing in legibility. Figure seven extends below the base line. Our figure eight begins at the upper left side, while some who make this figure well begin on opposite side. The upper part of figure nine rests on base line, with stem extending below. Close the upper part.

How to Practice.

In making the figure one, draw the hand toward you with a quick, light motion, sliding on the third and fourth fingers. Uniformity in height and slant are the two important points to observe.

The development and application of a lateral oval motion will aid in the construction of the figure two. In making the figure two in class drill a count of three should be used, 1, 2, 3, 1, 2, 3, etc., or dot, 2, 3.

Notice the exercise preceding the figure three. The motion used in that exercise will produce a good figure three if properly applied; 1, 2, 3, or dot, 2, 3 is the count used. A count of three is also used in four and five, but for six, seven and nine, a count of two.

Several lessons should be given to drilling on the figures singly before grouping them, but as soon as the forms are mastered and the student can make them at a fair rate of speed, it is best to drill in a miscellaneous order somewhat as follows: 1, 0, 2, 6, 9, 8, 5, 4, 3, 0, 9, 6, 7, 2, 8, 9, 3, 5, 6, 9, 2, 1, 5, 8, 6, 9, 5, 4, 6, 9, 3, 7, 8, etc. No particular order is necessary, but the aim should be to repeat one figure as often as another.

Rate of Speed.

Figures taken singly, 150 naughts, 175 ones, 80 twos, 75 threes, 80 fours, 75 fives, 100 sixes, 95 sevens, 90 eights and 100 nines per minute. Figures taken promiscuously, not less than ninety-five good figures to the minute. This rate can be increased materially by repeated effort. Persistence brings success. Practice steadily and faithfully.

A COMPLETE SCHOOL OF SHORT HAND AT HOME

. . . BY . . .

RUPERT P. SO RELLE

Late Director of the Commercial Department
Armour Institute

ASSISTANT TO

JOHN R. GREGG

Author and Inventor of "Gregg Shorthand"

WRITING OUT SHORTHAND NOTES ON THE TYPEWRITER.

The Gregg System of Shorthand.

EXPLANATION OF ALPHABET.

The consonants in the first line are written from left to right; those in the second line downward. The two signs for s and that for sh are written downward, while those for th are written upward.

The group of vowels ŏ, aw, ō is spoken of as the "downward hook"; the group ŭ, ŏŏ, ōō, as the "upward hook."

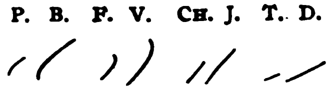
For the syllables given in the table of blended consonants, write the sign shown in the second column.

Write the sounds of each word and omit all silent letters; thus for eight write *āt;* for dough write *dō.*

CONSONANTS.

K. G. R. L. N. M.

P. B. F. V. CH. J. T. D.



down down down up

S. TH. SH. H.

or or

down up

BLENDED CONSONANTS.

COMPOSED OF

TeN, DeN

TeM, DeM

eNT, eND

eMT, eMD

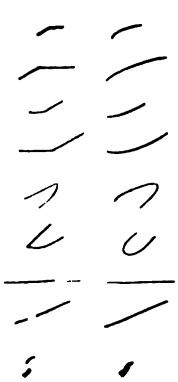
DeF, DeV

JeNT, JeND

MeN, MeM

TeD, DeD

SeS



VOWELS.

Short.	*ă as in* act	
Medium. A	*ä* " ark	
Long.	*ā* " aim	
Short.	*ĭ as in* rim	
Medium. E	*ĕ* " red	
Long.	*ē* " reel	
Short.	*ŏ as in* odd	
Medium. O	*aw* "audit	
Long.	*ō* " oak	
Short.	*ŭ as in* up	
Medium. U	*ŏŏ* "hook	
Long.	*ōō* "doom	

DIPHTHONGS.

	COMPOSED OF	
U	*ē-ōō*	
OW	*ä-ŏŏ*	
OI	*aw ē*	
I	*ä-ē*	

SELF INSTRUCTION IN SHORT-HAND WRITING

ITS VALUE AND USE.

IT IS strange that the origin of two of the greatest instrumentalities that have made for civilization, and have been so potent a factor in the progress of the human race—writing and shorthand writing—is wrapped in entire obscurity. The origin of writing, as of shorthand, is involved in uncertainty, although many ingenious hypotheses have been advanced by learned philologists attempting to locate definitely the time in the development of the world when man first communicated with man by the aid of written signs, and when the first attempt was made to record such utterances. This much, however, is certain, communication by signs is almost as ancient as speech itself.

Shorthand—When First Introduced.

When shorthand was first used has been the theme of writers for many generations, some attempting to trace it back to the time of the Phœnicians and the Hebrews, but the views of these writers are unsupported by history. Passages from the Bible and the apocryphal fourth book of Ezra have been quoted as authority for such an assumption, notably: "My tongue is the pen of a *ready writer*"; "When Jeremiah called Baruch, the son of Neriah, and Baruch wrote from the mouth of Jeremiah all the words of the Lord which he had spoken unto me with his mouth, and then wrote them with ink in the book." While it is reasonable to suppose that Baruch wrote from dictation—taking the words from the mouth of Jeremiah—the assumption that he wrote shorthand would hardly be tenable. Frequent mention is made in the literature of those days, of the "ready writer" or "quick writer," which naturally leads us to believe that there were in those times persons who followed the profession of amanuensis, and it would be logical to suppose that they used some brief signs in order to facilitate their work; but that there was a system of shorthand writing, as we now know it, is hardly probable.

If such a valuable art as shorthand writing had been known at that time some mention of it surely would be found in the literature of the people, but nowhere in the writings of the Jews before the birth of Christ do we find any allusion to it. On the other hand, after the birth of Christ, frequent mention is made of "competent quick writers."

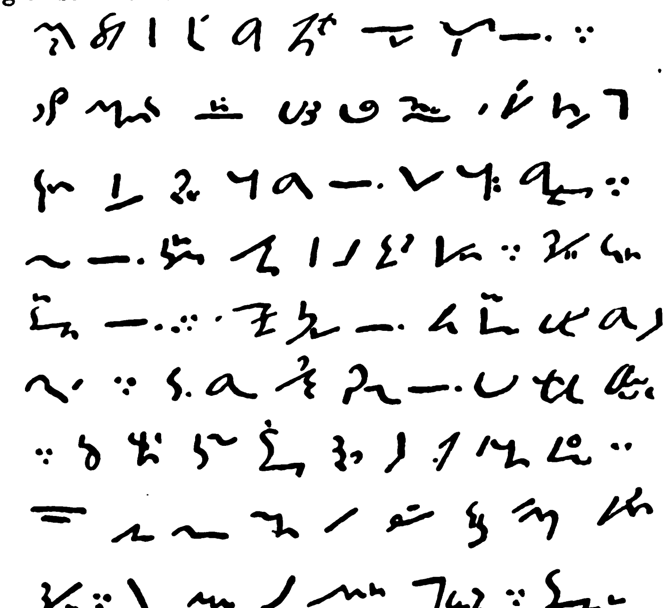
Proäresius in Eunapius said: "I wish that quick writers be given to me, and assigned to a place before the eyes of all, that they may daily note down the sentences of Themes, while this day I want them to follow me word for word."

Mr. Norman P. Heffley's translation of "Geschichte und Literatur der Geschwindschreibkunst von Dr. Julius Woldemar Zeibig" (Ancient and Mediaeval Shorthand), after reviewing the assertions of different writers on the antiquity of shorthand writing, says:

Shorthand the Servant of Oratory.

"If we consider what value and significance the art of oratory had in Greece, that it was the constant companion of statesmanship; if we consider, which is undoubtedly the case, that mention was made in writings of the ancients and by the commentators on the same, of all particulars regarding public orators,—then it is equally sure that so powerful an innovation as shorthand writing, the best servant of oratory, would have been mentioned, not merely incidentally, but specifically, if this art had really been invented and practiced in Greece before the days of Cicero.

"Primarily let us ask, if a contemporary of Xenophon knew anything about tachygraphy, how is it that no one alluded to this art? We have not found a passage from which proof against the existence of this art can easily be adduced. We alluded to the words of Thucydides: 'As respecting speeches made by the individuals either when they are about to begin war, or when they are fairly in it, it was difficult for me to retain in the memory with accuracy that which had been spoken and heard by myself, as well as that which was reported to me from other places; but as the individuals, according to my opinion, seem to have spoken most appropriately upon the subject in question, I shall here give as near as possible the whole meaning or sense of what was said.'"



SPECIMEN OF TIRONEAN NOTES BY MARCUS TULLIUS TIRO.

In about the year 63 B.C. tachygraphy was known and practiced in Rome. It has been claimed that Cicero was the founder of shorthand, but history does not support the claim. It is easy to believe that he furthered the art to the best of his ability because of the advantages it offered him, but undoubtedly to Marcus Tullius Tiro, the freedman and friend of Cicero, belongs the honor of having invented the system of shorthand writing which has been preserved to us in the Tironean notes, our knowledge of which is gained from the wax tablets which were in general use by the Romans at that time.

Among his contemporary practitioners of the art were Vipsanius Philargyrus, a freedman of Marcus Vipsanius Agrippa; Aquila, a freedman of Caius Cilnius Maecenas.

Pliny the younger relates of Pliny the elder, that he constantly had a writer at his side.

From the decline of the Tironean notes until the sixteenth century stenography in its true sense was not known. During the Middle Ages nothing was heard of shorthand.

Bright's Method of Shorthand.

In Elizabeth's time, 1588, a work on shorthand writing by Timothe Bright, "Doctor of Phisike," was brought out, entitled "Characterie—an arte of shorte, swifte and secrete writing by character." Dr. Bright was a well-known physician of his day, was, for a time, physician in St. Bartholomew's Hospital, London, and later a rector of churches at Methley and Berwick-in-Elmet, in Yorkshire. He is also known as the author of several medical and religious works. His system of shorthand was dedicated to Queen Elizabeth.

Bright's method was very crude and wholly incapable of accomplishing the purpose for which it was invented. The following are the alphabetical signs used:

a b c d e f g h i l m n o p r s t u

"K" and "q" were represented by the same sign as "c." Although the system was not alphabetical, the author alludes to the signs as such. Each character was given four slopes, and there were twelve ways of varying the base, thus forty-eight words could be written with each letter of the alphabet by varying the base.

Bales' System of Shorthand.

Two years after Bright's treatise appeared, Peter Bales, a teacher of penmanship, brought out a work on shorthand, of which he stated, a knowledge may "easily be attained by one moneth's studie, and performance by one moneth's practice." Thus we find a precedent for the "short-term" method of stenography at almost the inception of the art, a question which has ever since been the cause of dissension and wrangle among its teachers and promulgators.

Willis' System.

The next candidate for honors in shorthand authorship was John Willis, a Bachelor of Divinity who, in 1502, published anonymously at London, "The art of stenographie,

teaching by plaine and certaine Rules, to the Capacitie of the meanest, and for the use of all professions, The way of Compendious writing." To this author is due the credit for using a true stenographic alphabet. Willis discarded superfluous letters, and thus paved the way for the phonetic representation of words. "In every word," he said, "those letters are to be omitted which are rarely or not at all found, whether they be vowels or consonants." Later this author published another work under his own name, entitled, "Spelling Characterie." This system had quite a vogue for a time, for it passed through thirteen or more editions.

In 1618 a work entitled, "An Abbreviation of Writing by Character," in which new characters were chosen for most of the letters, was brought out by Edmond Willis.

Other Systems.

After the success of Willis' system no fewer than half a dozen systems were published before the advent of "Semography" by William Cartwright, printed in 1642 by Jeremiah Rich, his nephew. This system attained great prominence, and several modifications of it were brought out by different authors.

Following in Cartwright's path William Mason, thirty years later, published "A Pen Pluck'd from an Eagle's Wing." Many imitators of Mason sprang up, and it was from the system of this author, "La Plume Volante," published about 1720, that Thomas Gurney got the material which he used in his work as a stenographer. Extending over the next one hundred and thirty years, twenty editions of Gurney's works were issued.

In 1767 the system of shorthand invented by John Byrom, a fellow of the Royal Society, was published. The title of this book was "The Universal English Shorthand," and it was published some time after Byrom's death. It is still used to some extent in England.

In 1778 Dr. William Fordyce Mavor published a system which he afterward revised and republished under the title of "Universal Stenography." This system became very popular, passing through ten editions, and is still used by a few writers in London.

Following Byrom, Samuel Taylor published, in London, 1786, a system which marked another era in stenographic literature. This system, like many of its predecessors, became very popular, and inspired with ambition numerous imitators. It was modified by Odell, Harding, Gould, and others, and in this form passed through many editions. Isaac Pitman, whose work is mentioned later, was a writer of Taylor's system for seven years previous to the publication of his work. Mr. Jacob Pitman, in giving a biographical sketch of his brother Isaac before the Victorian (Australia) Phonetic Society many years ago, said: "During this period of his life (between 1830-1837) we both wrote Taylor's system as improved by Harding." In many respects there is a close resemblance in the first alphabet between Pitman's consonantal representation and in the pairing of consonants and that of Taylor. It is not unlikely that Pitman received his inspiration from Taylor's system.

In the early development of the art of shorthand writing the work was done almost exclusively in England. In Germany and France and other European countries phono-

graphic writers seemed content to adapt to their language the systems devised in England. Jacques Cossard published the first method in France in 1651.

The earliest method published in Germany was an adaptation of Shelton's English system, in 1679. The two leading German systems of to-day are those of Gabelsberger and Stolze. Stolze's method was not published until seventeen years after its invention.

Modern Shorthand.

With the publication of Isaac Pitman's shorthand, entitled "Stenographic Soundhand," in 1837, the greatest epoch in the history of English shorthand began. Pitman's shorthand may be said to be the first of the really scientific instruments of rapid writing that have been devised, and the inspiration of the wonderful development of the art that has taken place since its invention. Through its development by numerous adapters, Pitmanic shorthand is known, in one form or another, in every country of the globe.

In 1840 Pitman brought out a new edition of his shorthand, in which was introduced numerous changes, and the system was called "Phonography." New editions were brought out in rapid succession and the system was further developed and improved until 1857, when the tenth edition appeared with a reversal of the vowel scale. This innovation produced a revolt among the writers of the system. The change was generally accepted in England, but in America phonographers as generally rejected it.

The contest over this bone of contention was long and determined. Benn Pitman, a brother of Isaac Pitman, who had brought this system to America in 1855, adhered to the old vowel scale, as did also Andrew J. Graham (1854), and the other phonographic publishers.

Of the twelfth edition Mr. Pitman said: "We have used up all the stenographic material, and, as we—who know the system so well—believe, have used it in the best manner. If anyone can produce additional material—some stenographic sign, any hook or crook or circle or straight or curved stroke, in any direction, that is not employed in stenography, or of which he can show a better use—we are willing to listen to him; but until some such proposition as that comes before us there will be no change in phonographic writing."

Shorthand in the United States.

Shorthand has been used to some extent in the United States since its earliest publication in England. During the early days of the republic a considerable number of works based on Gurney's and Taylor's systems was brought out. After the publication of Pitman's phonography numerous imitators of it appeared in America.

In 1854 the first of the Graham publications by Andrew J. Graham appeared, "The Reporters' Manual, a Complete Reporting Style," which was but the beginning of the prolific promulgation of phonographic literature of the Graham system. To Mr. Graham belongs the credit for having so perfected the Pitman system as to make it an adequate instrument for reporting purposes. The success of Graham's phonography was the cause of its being widely imitated, and at present text-books by a large number of different authors are published.

In 1867 "The Complete Phonographer," by James E. Munson, official stenographer of the New York Superior Court, appeared. Mr. Munson adopted the vowel scale used in the "tenth edition" of Isaac Pitman's Phonography, as well as nearly all the consonantal characters. Both Graham's and Munson's shorthand have attained great popularity, and probably are the best known of the American Pitmanic systems.

Some of the well-known systems based on the original Pitmanic alphabet are: Graham, Benn Pitman, Munson, Lindsley, Osgoodby, Scott-Browne, Day, Barnes, and Dement.

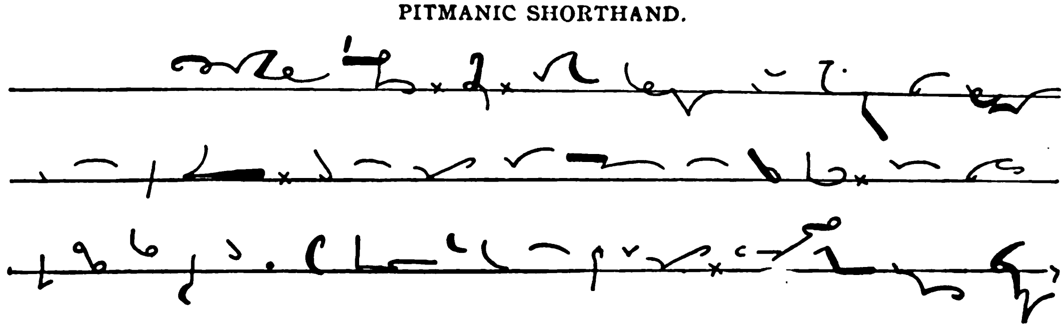
Of another school of authors using an entirely different basis for their systems are: Pernin, Cross, Sloan (Sloan-Duployan), McKee, and others.

Up to 1893 nearly all the work of American phonographic authors, with the possible exception of Cross, was done along the line of developing the Pitmanic system. So it may be said that these systems reached the acme of their development many years ago. As Mr. Pitman had said, "all the stenographic material had been used," thereby implying that if there was to be further development along the line of phonographic research and invention, it would have to be accomplished by different means than that adopted in the Pitmanic system and its numerous modifications.

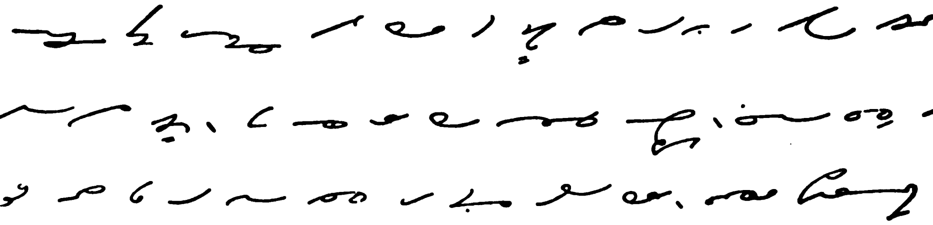
The Most Popular System of To-day.

In 1893 there was introduced into this country a system by Mr. John R. Gregg, of Liverpool, England, entitled "Light Line Phonography," based on longhand. The invention of this may be said to have marked the beginning of the third and most important era in the evolution of shorthand writing. Phonographers had realized that the possibilities of a system based on the geometrical foundation had long since been exhausted, and that improvements in that direction could not be made, but there was also as full a realization that the limit of phonographic perfection had not by any means been reached. Therefore with the advent of Gregg Shorthand (the title Mr. Gregg later gave to his system), there sprang into existence a new interest in shorthand, and a revolutionary movement began that has reached every part of the civilized globe. There began at once an appalling defection in the ranks of Pitmanic writers; schools that for years had taught one or the other of the Pitmanic modifications, began to investigate and adopt the new system.

PITMANIC SHORTHAND.



GREGG SHORTHAND.



Mr. Gregg struck out boldly on new lines. The characters of his system are taken from ordinary longhand, which, as the author says, "in the adaptability to the hand embodies all the wisdom of the ages." He uses neither position nor shading, but joins vowels and consonants in their logical sequence and in the order of their delivery in spoken language. Studying closely the causes for the failure of Pitmanic phonography to meet the exacting requirements of a modern civilization, the author of Gregg shorthand, through scientific research, became convinced that shading, position writing, the innumerable exceptions to rules, and the arbitrary characters that abound in the Pitmanic system and its modifications, would have to be abolished in a system that would endure. After exhaustive experiments an alphabet was evolved based on the fundamental phonographic truth, that the value of a letter or shorthand character is determined by its combination with other letters or characters. By the wise selection of the characters for the alphabet, the frequent syllables or combinations of sounds in the language, could be expressed by one stroke of the pen, and with the further great advantage of securing a full phonographic representation. The following brief synopsis will suffice to show the closeness with which the author adhered to great natural principles that govern ordinary longhand, and the resultant legibility:

As in Ordinary Writing:

1. No compulsory thickening; may be written either light or heavy.
2. Written on the slope of longhand, thus securing a uniform manual movement.
3. Position writing abolished; may be written on unruled paper and in one straight line.
4. Vowels and consonants are joined and follow each other in their natural order.
5. Angles are rare; curves predominate.

Gregg shorthand has received the highest scientific endorsement ever given to a system of shorthand, as will appear from the following taken from "Researches on Movements Used in writings," by Cloyd N. McAllister, Ph.D., of the Yale Psychological Laboratory: "For the student of stenography the question of speed is of the greatest importance. The older systems contain many characters that must be made in the direction of the radii of quadrant IV. (the most difficult). These movements are very slow, requiring twenty-seven per cent more time on the average than the movements of quadrant III. (the least difficult).

"One system of shorthand introduced into this country in 1893, Gregg shorthand, contains no characters that must be made in either quadrant II. or IV., and the slope of the

characters is such that they lie very near the middle of the quadrants I. and III. In this respect, then, *this system of shorthand is the most rapid yet devised.*"

In spite of the fact that Mr. Gregg brought his system to the United States at a time when the country was in the throes of a financial panic, and that it was met by the most violent opposition by the ultra-conservative element of the profession, the system sprang almost instantly into popularity. It is in use at present in a larger number of commercial and high schools than any other. Its writers are engaged in every branch of stenographic work from amanuensis to the most difficult reporting, where speed and legibility are indispensable.

Future Prospects of the Shorthand System.

The field for shorthand is ever widening and with this extension of its usefulness, there comes a constantly increasing demand for greater proficiency. The business men of the United States so quickly realized the value of shorthand that almost anyone who called himself a stenographer could obtain a situation. But of late years the business has steadied down to a good basis and the demand for really first-class stenographers is greater than ever before. The unparalleled business expansion of the last few years has given an impetus to shorthand that it has never known before. In New York last year one of the large typewriting concerns placed over 5,000 stenographers in positions, the salaries averaging about $50 a month. In Chicago the same concern placed almost as many with only a slight decrease in the average salary. The same was true of all the large cities.

Typewriting.

Another innovation in the shorthand business that has given it greater prominence, has been the introduction of what is known as touch typewriting, by which is meant the operation of the typewriter without looking at the keys. By this method fully fifty per cent in efficiency is gained, and with it greater accuracy. Besides adding to the efficiency of the typewriter operator, touch typewriting has had the effect of forcing shorthand writers to become proficient in order that the shorthand notes might be read more rapidly to keep pace with the additional speed on the typewriter. Touch typewriting is now taught in all the leading commercial schools, and there are many text-books on the subject.

During the last five or six years, the question of teaching shorthand and typewriting in the public schools has been much agitated, and in the larger cities, the high schools and especially the evening schools are taking up this work, and the demand for it seems to be constantly increasing.

Rules for Joining Circles.

When joined to a curve the circle is turned on the inside of the curve.

eke	ē k	hack	h ă k
key	k ē	lay	l ā
ear	ē r	ill	ĭ l
egg	ĕ g	era	ē r ă
ale	ā l	gay	g ā

Between two reverse curves the circle is turned on the back of the first curve.

kill	k ĭ l	rack	r ă k
wreck	r ĕ k	lake	l ā k
gear	g ē r	trick	t r ĭ k
rig	r ĭ g	rag	r ă g

When joined to straight lines, the circle is written forward—as the hands of a clock move.

aim	ā m	day	d ā
me	m ē	may	m ā
him	h ĭ m	mean	m ē n

When two characters join with an angle, the circle is written on the outside of the angle.

rear	r ē r	meek	m ē k
keg	k ĕ g	net	n ĕ t
team	t ē m	gain	g ā n

The downward hook represents the short sound of *o*, heard in *hot*, *top;* a dot beneath the hook indicates the sound of *aw*, as in *awe*, *law;* while the short dash indicates the long sound, as in *owe*, *no*.

ŏ	rot	r ŏ t
aw	wrought	r aw t
ō	wrote	r ō t

The downward hook is placed on its side *before n*, *m*, *r*, *l*, except when preceded by a downward character.

on	ŏ n	coal	k ō l
or	aw r	omit	ō m ĭ t
moan	m ō n	home	h ō m
nor	n aw r	dawn	d aw n

When preceded by a downward character, the hook retains its usual form.

bore	b ō r	pole	p ō l
bone	b ō n	foam	f ō m
shoal	sh ō l	borrow	b ŏ r ō

The upward hook represents the short sound of *u*, heard in *hum*, *dumb* (not the long sound of *u* heard in *use*); a dot beneath the hook indicates the sound of *oo*, in *took*, *foot*, while the short dash indicates the long *oo*, as in *doom*, *boom*.

	ŭ	tuck	t ŭ k
	o͝o	took	t o͝o k
	o͞o	tomb	t o͞o m

To avoid an angle, the upward hook is dropped on its side *after n* or *m*.

nun	n ŭ n	muff	m ŭ f
mood	m o͞o d	nook	n o͝o k
moon	m o͞o n	mug	m ŭ g

The upward hook is also dropped on its side after *k* or *g*, *when followed by r* or *l*.

cool	k o͞o l	gull	g ŭ l
curry	k ŭ r ĭ	Gurney	G ŭ r n ĭ

W and Y.

W is expressed by the sign for *o͞o*, because it is equivalent to that sound when followed by a vowel, as, o͞o-â-t—*wait*.

we	w ē	wall	w aw l
weave	w ē v	woe	w ō
wait	w â t	wool	w o͝o l

The combination *wh* is really sounded *hw*, as h-w-ē-l—*wheel*, and is therefore expressed by a dot placed over *w*.

whit	hw ĭ t	whack	hw ă k
whig	hw ĭ g	wheat	hw ē t
wheel	hw ē l	whim	hw ĭ m

The vowel *e* is equivalent to *y*, as ē-ō-r—*yore*, and a special sign for *y* is therefore unnecessary.

yacht	y ŏ t	yore	y ō r
yawn	y aw n	yawl	y aw l

At the beginning of a word it is more convenient to express *ye* by a small loop, and *ya* by a large loop. Where necessary the dot or dash may be used to denote the exact vowel sound.

ye	yē	yellow	yĕ l ō
yea	yā	yam	yă m
yet	yĕ t	Yale	Yā l

Word-Signs and Phrases.

A large proportion of all written and spoken language is made up of a few simple words repeated over and over again; indeed, it is computed that about one hundred of these words comprise more than one-half of all ordinary language. In all systems of shorthand, brief forms are provided for such words, and the following list should be committed to memory before proceeding further:

can	at, it
go, good	would
are, our	he
well, will	I
in, not	a, an (dot)
am, more	the (th)
	up

of
all
you, your
care
call
far, favor
fall, follow
put
be, but
for
have
change, which
shall, ship
before
about
after
ever-y
name
form, from
been, bound
give-n
please
let, letter
Mr., market
body
judge
keep
friend-ly
public
full-y
look
for the
in which
in which the
I have
I have not
I shall
I shall not
I shall have
from the
may be
would be
the letter
will not be
which have
please ship
please ship the
please have

ONE HUNDRED WAYS TO MAKE MONEY

THIS is a practical age, and the one who accumulates more than the average amount of wealth is envied by his acquaintances, and pointed out as a man who has made a success of life.

The following ideas are offered to those who desire to increase their incomes, and to those who are dissatisfied with their present employment, and wish to turn their attention to new fields of endeavor. It is not claimed that all the plans offered will be of use to each individual case. A clerk in a Chicago department store could hardly hope to make a fortune raising sheep, and a farmer in Dakota would probably meet with failure should he attempt to establish a sewing school, but it is hoped that each one who reads this chapter may find some hint that will prove of financial benefit, and lead to the enlargement of his bank account.

If you have a garden, arrange to supply the local merchants with fresh vegetables during the season. Or, better still, make a house to house canvass in your nearest town, and arrange to call daily during the season with fruits and vegetables fresh from your garden. Here are the six articles which grocers say sell for the largest profit.

1. *Asparagus.*—Arrange it attractively in small bunches. The white variety is considered the most palatable.

2. *String Beans.*—Nothing is easier to raise, and the demand will exceed the supply.

3. *Peas.*—When in the pod they are not particularly attractive, but very young peas when shelled and taken to market in bright tin pails are irresistible.

4. *Green Corn.*—A great luxury. The first on the market commands fancy prices.

5. *Tomatoes.*—The larger the better. They command a good price, and as a thrifty vine will bear fifty, the profits are very large.

6. *Fresh Strawberries.*—Pick them fresh every morning. Put in boxes so that they will appear attractive, with two or three unusually large ones on top, surrounded by a few leaves. Always give good measure, and your customers will wait for you.

7. *Dairy Products.*—Butter, eggs, milk and cheese, all these yield immense profits to the one who understands the dairy. If you have facilities for keeping hens, you can add greatly to your income.

8. *Big Peaches.*—When ordinary peaches were selling at twenty-five cents a bushel, a grower received $2.00 a bushel. This is how he did it. When the fruit was as large as a hickory nut, he employed a large force of laborers and picked off more than one-half the fruit. The rest ripened early, grew large, and was of excellent quality. His net profit that year from eleven acres was between $3,000 and $4,000.

9. *Pickles.*—As many as 150,000 cucumbers have been grown on one acre of land, and at the low price of $1.50 per thousand this means $225 per acre.

10. *Beets.*—Even when sown a foot apart, it is possible to grow 80,000 beet roots on an acre of ground. They easily command $1.00 per hundred, and deducting one-half for expenses, there results a net profit of $400.

11. *Horseradish.*—The root requires but little cultivation. Instead of selling it in bulk, grate it yourself, put it in fancy bottles, and sell to consumers.

12. *Tobacco.*—Where tobacco can be raised, farmers have abandoned nearly every other crop. The profits are enormous.

13. *Tree Nursery.*—The expense of a tree nursery is almost nothing beyond the first investment. An acre of ground will hold about 44,000 small trees. The average price is about nine cents each. If you can make a market, there is wealth in the business.

14. *Onions.*—In some sections of the country, as high as one thousand bushels to the acre have been raised. They seldom sell for less than seventy-five cents per bushel.

15. *Apples.*—A man in New England said that after forty years' experience, raising all kinds of crops, he found his apple orchard brought him a greater profit than any other crop on his 200 acres of land.

16. *Christmas Trees.*—If you live in a section where evergreen trees abound, cut the smaller ones a few weeks before Christmas, and ship them to the city. Christmas trees sell for from fifty cents to five dollars, and you can cut thousands from a single acre. Wreaths made of holly and ground pine also sell rapidly.

17. *Double Vegetable Culture.*—A New Jersey farmer has conceived the idea of grafting tomatoes on potato vines, or an air crop on a root crop, thus raising vegetables at both ends. This is an idea for growers who have only a limited space, and where land is high.

18. *Growing Nuts.*—Land that is not available for ordinary farming purposes may be utilized for growing nuts. The crop requires but little care, and there is a constant demand at good prices. The chief pomologist at Washington, D. C., says: "The cultivation of nuts will soon be one of the greatest and most profitable industries in the United States."

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WOMAN'S WORK.

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54. *Flower Seed Packets.*—Buy quantities of flower seeds of all varieties. Put them in small envelopes, a few seeds in each, and advertise that you will send samples for a penny a kind, ten for six cents, twenty-five for fifteen cents, fifty for twenty-five cents, etc. A large mail envelope will hold fifty or more of the smaller ones containing the seeds.

55. *Selling Books by Subscription.*—This is a profitable work and one in which any person past the age of eight or ten years can engage. It needs no special training or no especial talent. The "selling of books" has been the stepping stones of more great men and women than any other one employment. Daniel Webster paid his second term's tuition at Dartmouth by canvassing for De Tocqueville's "America." In the rooms of the Massachusett's Historical Society may be seen a canvassing book used by Longfellow, on one of the leaves of which is his first draft of his poem "Excelsior." Prince Bismarck, when a student at Heidelberg, during a winter's vacation, canvassed for one of Blumenthal's hand books. George Washington tells how prior to the Braddock defeat he sold, in the neighborhood of Alexandria, 200 copies of Bydell's "American Savage." The reason for this is that good books are educators. The work, though hard, is elevating, ennobling and helpful. Dr. Spurgeon said: "There is no other business so honorable or beneficial to mankind as the business of selling good books." The great American divine, Dr. Talmage says: "I

always feel like taking off my hat to the book agent. He is doing more good than I can ever hope to do." Besides the good one can do, the work is profitable. The best books to-day are sold only by subscription. In days gone by, the subscription book man thought he could palm off any old book on the innocent public, but to-day all this is changed. The best authors place their books in the hands of subscription book houses for sale. Subscription book men are wide awake, they at once put these books in the hands of agents and in one year alone often as high as seven and eight hundred thousand copies of one book alone are sold. Histories, biographies, atlases, dictionaries, etc., etc., find their way into the most common of homes. Thus it is that the boy and girl on the remote mountain side and obscure valley is to-day as well read as the lad and lass of our large cities. Books are the educators, agents are the reapers. If you have a friend who needs employment recommend him to a good subscription publishing company and get him started on life's pathway.

MONEY IN INVENTIONS AND DISCOVERIES.

There is no enterprise known to the business world where the possibilities for accumulating a fortune are so great as in successful inventions. Millions of dollars have been made in the past, and the field is still unlimited. New articles for the use of mankind, and improvements on old ones are constantly being placed on the market, bringing rich rewards to the fortunate discoverers. A few suggestions are offered which may be of use to those whose talents lie in this direction.

56. *Floor Coverings.*—Carpets are expensive; matting is not elegant. Discover something in place of both, cheap and ornamental.

57. *Water Tank.*—Instead of the water tank on the top of a tower or country dwelling, with its liability of leakage and destruction of property, why not put it in the cellar and operate it by means of compressed air? By placing it in the cellar or underground, the water could be drawn cool and fresh, and in winter it would be much better protected from freezing.

58. There are many washing machines on the market, but none so far has driven out the old-fashioned washboard and tub. A good one that can be sold cheap will do it.

59. *A Stove Damper.*—One that will close the draft automatically, when the state of the fire warrants it.

60. *Cold Handle.*—A separate handle which could be instantly applied to utensils on the stove and remove them without burning the hands.

61. *A Can-Slide.*—A fortune awaits the person who will invent a can-slide which will effectually keep the food airtight, and which at the same time may be easily opened.

62. *A Noiseless Clock.*—The ticking of clocks is very annoying to many nervous people. Who can invent one that will perform the work silently?

63. *Ice Machine.*—Produce one so small and cheap that it may be used in every house.

64. *Book Lock.*—A small contrivance which can be attached to the edges of a book. Private correspondence, cash books, etc., could then be guarded during the absence of the owner.

65. *Scissors.*—A scissors or shears that will cut round as well as straight would be bought by everyone who uses a needle.

66. *Gas Detective.*—A device to be placed on a gas fixture to ascertain instantly whether it leaks. There is frequently an odor of gas when it is difficult to tell from whence it proceeds.

67. *Towels.*—Paper towels having the quality of cloth, yet designed for a single use, will make a fortune for their first maker.

68. *Cement.*—A cement which will take the place of pegs, nails and threads in the manufacture of shoes would revolutionize the trade.

69. *A Paper Match.*—The National Druggist says: "The time-honored scheme of rolling up a piece of paper and using it for a lighter could be utilized by an inventor in the manufacture of matches. The matches would be considerably cheaper than the wooden ones, and also weigh less, a fact which counts for much in the exportation."

70. *Bottles.*—If a paper bottle could be made as serviceable as glass, its many advantages would insure a fortune for the inventor.

71. *Horse-Fastener.*—A contrivance by which a rider can fasten his horse and unfasten him without alighting would meet with ready sale.

72. *A Corn-Cutter.*—A machine to run between the rows and cut the stalks on each side would sell to every farmer.

73. *Fertilizer-Distributer.*—One constructed on the plan of a sprinkling cart would be a great saving in farm labor.

74. *Bone Cutter.*—A cheap bone cutter, by which bones could be cut into small bits for fowls, would appeal to every poultry raiser. Bone is an egg-producer, but no cheap means has yet been invented for utilizing this kind of refuse.

75. *Well Refrigerator.*—Farmers often keep articles in the well, but if an accident to the rope occur, the articles of food are often spilled, thus entailing great annoyance and expense. Invent a way by which a well may be a safe ice-box.

76. *Portable Fence.*—A fence of which the posts are made of steel or iron, tapering at the end so as to be readily driven into the ground. Such a fence could be carried in a wagon and set up anywhere in a few minutes.

77. *Paper Milk Can.*—If milk cans could be constructed of paper, the saving in cost of transportation would be a boon to every dairyman.

78. *Egg Preserver.*—No process has yet been found for preserving eggs for months and keeping them as fresh as newly-laid ones. Here is a chance for a practical chemist.

79. *A Flameless Torch.*—An igniter which will cause combustible matter to burn, but will not itself flame—a device which will instantly ignite a lamp by thrusting it down the chimney, or light the gas without the usual search for a match, would meet with ready sale.

80. *Galvanized Iron.*—The amount of galvanized iron used is enormous, and the range of its usefulness is constantly increasing. A process which will reduce the cost of galvanizing even in the slightest degree would be a bonanza for its inventor.

81. *Metal Extractor.*—A solution which will precipitate gold or silver from the ore. Such an invention would revolutionize the mining industry.

MISCELLANEOUS WAYS TO GAIN RICHES.

82. Many of our wealthiest men have made their money in mining industries,

8. *Big Peaches.*—When ordinary peaches were selling at twenty-five cents a bushel, a grower received $2.00 a bushel. This is how he did it. When the fruit was as large as a hickory nut, he employed a large force of laborers and picked off more than one-half the fruit. The rest ripened early, grew large, and was of excellent quality. His net profit that year from eleven acres was between $3,000 and $4,000.

9. *Pickles.*—As many as 150,000 cucumbers have been grown on one acre of land, and at the low price of $1.50 per thousand this means $225 per acre.

10. *Beets.*—Even when sown a foot apart, it is possible to grow 80,000 beet roots on an acre of ground. They easily command $1.00 per hundred, and deducting one-half for expenses, there results a net profit of $400.

11. *Horseradish.*—The root requires but little cultivation. Instead of selling it in bulk, grate it yourself, put it in fancy bottles, and sell to consumers.

12. *Tobacco.*—Where tobacco can be raised, farmers have abandoned nearly every other crop. The profits are enormous.

13. *Tree Nursery.*—The expense of a tree nursery is almost nothing beyond the first investment. An acre of ground will hold about 44,000 small trees. The average price is about nine cents each. If you can make a market, there is wealth in the business.

14. *Onions.*—In some sections of the country, as high as one thousand bushels to the acre have been raised. They seldom sell for less than seventy-five cents per bushel.

15. *Apples.*—A man in New England said that after forty years' experience, raising all kinds of crops, he found his apple orchard brought him a greater profit than any other crop on his 200 acres of land.

16. *Christmas Trees.*—If you live in a section where evergreen trees abound, cut the smaller ones a few weeks before Christmas, and ship them to the city. Christmas trees sell for from fifty cents to five dollars, and you can cut thousands from a single acre. Wreaths made of holly and ground pine also sell rapidly.

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65. *Scissors.*—A scissors or shears that will cut round as well as straight would be bought by everyone who uses a needle.

66. *Gas Detective.*—A device to be placed on a gas fixture to ascertain instantly whether it leaks. There is frequently an odor of gas when it is difficult to tell from whence it proceeds.

67. *Towels.*—Paper towels having the quality of cloth, yet designed for a single use, will make a fortune for their first maker.

68. *Cement.*—A cement which will take the place of pegs, nails and threads in the manufacture of shoes would revolutionize the trade.

69. *A Paper Match.*—The National Druggist says: "The time-honored scheme of rolling up a piece of paper and using it for a lighter could be utilized by an inventor in the manufacture of matches. The matches would be considerably cheaper than the wooden ones, and also weigh less, a fact which counts for much in the exportation."

70. *Bottles.*—If a paper bottle could be made as serviceable as glass, its many advantages would insure a fortune for the inventor.

71. *Horse-Fastener.*—A contrivance by which a rider can fasten his horse and unfasten him without alighting would meet with ready sale.

72. *A Corn-Cutter.*—A machine to run between the rows and cut the stalks on each side would sell to every farmer.

73. *Fertilizer-Distributer.*—One constructed on the plan of a sprinkling cart would be a great saving in farm labor.

74. *Bone Cutter.*—A cheap bone cutter, by which bones could be cut into small bits for fowls, would appeal to every poultry raiser. Bone is an egg-producer, but no cheap means has yet been invented for utilizing this kind of refuse.

75. *Well Refrigerator.*—Farmers often keep articles in the well, but if an accident to the rope occur, the articles of food are often spilled, thus entailing great annoyance and expense. Invent a way by which a well may be a safe ice-box.

76. *Portable Fence.*—A fence of which the posts are made of steel or iron, tapering at the end so as to be readily driven into the ground. Such a fence could be carried in a wagon and set up anywhere in a few minutes.

77. *Paper Milk Can.*—If milk cans could be constructed of paper, the saving in cost of transportation would be a boon to every dairyman.

78. *Egg Preserver.*—No process has yet been found for preserving eggs for months and keeping them as fresh as newly-laid ones. Here is a chance for a practical chemist.

79. *A Flameless Torch.*—An igniter which will cause combustible matter to burn, but will not itself flame—a device which will instantly ignite a lamp by thrusting it down the chimney, or light the gas without the usual search for a match, would meet with ready sale.

80. *Galvanized Iron.*—The amount of galvanized iron used is enormous, and the range of its usefulness is constantly increasing. A process which will reduce the cost of galvanizing even in the slightest degree would be a bonanza for its inventor.

81. *Metal Extractor.*—A solution which will precipitate gold or silver from the ore. Such an invention would revolutionize the mining industry.

MISCELLANEOUS WAYS TO GAIN RICHES.

82. Many of our wealthiest men have made their money in mining industries,

and it is safe to predict that many more will meet with the same good fortune. There is still gold in California, Arizona, Mexico and the Klondyke; silver in Colorado, copper in Michigan and Montana; lead and zinc in Missouri, and new bonanza kings may appear at any time.

83. *Patent Medicines.*—Great fortunes have been made from the manufacture and sale of patent medicines. No man lives who enjoys perfect health at all times, and medicines guaranteed to cure every disease under the sun may be found on the shelves of every drug store. Where there is such a supply it is evident that there is a demand. There is room for more, and if introduced in an attractive way, the public will respond.

84. *Real Estate.*—Handsome fortunes have been amassed by shrewd, careful speculators in land. In order to make a success of this business, capital is required, but with proper care, and a knowledge of market values, large sums of money may be made.

85. *Oil.*—A writer in the Electrical World says that petroleum is the coming fuel. It is probable that the immense sums of money made after the discovery of oil fields in Pennsylvania in 1865 will be discounted in the near future in sections of the west and south. Late discoveries in Texas and southern Louisiana indicate an inexhaustible supply of fuel oil, and the mountains of Wyoming appear to be a promising field.

86. *Cattle Raisers.*—A few years ago Grant Gillet was a station agent in a small Kansas town, working for a bare living. He secured a position as cattle feeder, and four years later he was worth half a million dollars, made by buying and selling cattle. Another man bought Texas cattle for $432,000, and four months later sold them for $540,000. This simply shows what opportunities there are for shrewd men of means in the cattle business.

87. *Hunting.*—Most men use the rod and gun for sport, but there are a number of persons who follow the business for a livelihood. Especially in the great forests of the north are found thousands of men to whom the skins of wild beasts may be said to be meat and drink. Some of them attain a competence and retire on their savings from the sale of furs.

88. *Building Materials.*—"A man who has a quarry of good building stone, easily accessible, is richer than if he owned a gold mine." This statement may be an exaggeration in many cases, but the fact remains that there are thousands of acres of land throughout the country useless for farming purposes, that contain quarries which if properly developed would bring their owners large returns.

89. *Wealth in Trees.*—The area of the pine forests in Michigan and Wisconsin is growing less every year, but there are still lumber districts in Texas, Georgia, and Louisiana of astonishing extent, and that offer opportunities for capital equal to any the world has ever known.

90. *Cotton Mills.*—The people who live south of Mason and Dixon's Line are beginning to realize the great value of the cotton mill to their section. Instead of shipping the raw material to New England, and having the manufactured article returned to them, thus paying double freight, they are turning their attention to securing mills for themselves. The field is an immense one, and no investment is surer of profitable returns

SALARIED POSITIONS.

There are many positions in which very large salaries are paid. As a rule, the remuneration is proportionate to the responsibilities involved, rather than to the actual labor required. The right man in the right place may always be sure of a rich reward.

91. *Advertising Agents.*—The great magazines and newspapers depend to a large extent on their advertising columns for their profits. The men who have charge of this department frequently receive as high as $10,000 a year.

92. *Editors.*—Editors of departments on great daily newspapers receive from $2,000 a year upwards. Many managing editors and editors-in-chief are paid five times that sum.

93. *Attorneys.*—Corporation lawyers, celebrated bar-pleaders, and specialists in many branches of the law, earn large sums of money. Single fees of $10,000 and over are not unusual.

93. *Physicians.*—Here, as in the legal profession, the great financial rewards are secured by specialists. Many doctors in our large cities have incomes of from $25,000 to $50,000 a year.

94. *General Managers.*—The manager of a leading department store in Chicago is paid $10,000 a year. He began his business career with the same employers, many years ago, at a salary of $7 a week.

95. *Electricians.*—This is a comparatively new field, but the rewards are very large. As in every other line of work, there is always room at the top. A young man employed in a New York establishment says: "I am in receipt of a salary of $4,000 as superintendent of the dynamo building, and recently I had an offer of $7,000 to go to a new company out west."

96. *Detectives.*—Besides the men regularly employed by the national and local authorities, there are many who own or work in private agencies. The pay depends on the nature of the work and the wealth of the employers.

97. *Press Clippings.*—Men like to read items about themselves which appear in print. The press clipping bureau gives them the opportunity. The profits depend on the number of clients it is possible to secure, but many of them do an enormous business, one in particular handling an average of 100,000 clippings a week.

98. *Experts.*—There are many kinds—accountant, color, handwriting, etc. Anyone who confines his life-work to a special field can command a large price for his services.

99. *Corporation Presidents.*—The largest salaried employees of the business world will be found among these men, and the extremes are wide apart. Five thousand dollars may be considered a very low figure, and there are a favored few who receive as high as $100,000, or even more.

100. Among other occupations and professions that command large salaries may be mentioned Government officials, who receive from $600 to $50,000; preachers, from $20,000 in the fashionable city church to a pitiful $300 in some country town; school teachers, from $250 to $4,000. A visitor at a factory where the superintending engineer was paid $25,000 a year was asked if the salary was not an extravagant one. The owner replied that he considered it cheap. Talent and skill are everywhere in demand, and when they are found almost any salary will be willingly paid.

THE FINSEN LIGHT CURE HOSPITAL—LONDON.

(For description see page 65.)

King Edward and Queen Alexandra visiting the patients. To Queen Alexandra may be given the glory of presenting the first lamp for this wonderful treatment at the London Hospital established in 1900.

REVIEW QUESTIONS FOR STUDENTS

AN EASY METHOD OF "POSTING UP" ON ANY GIVEN SUBJECT

THE following series of questions pertaining to the subjects treated in this volume is intended as a key to help unlock the great fund of information stored within its pages and to impress that information upon the mind. The list contains inquiries which point toward every quarter of human research and human achievement. It covers the universe, and touches all things which are wont to attract the attention and engross the minds of readers and thinkers.

As we stated in the introduction, the book itself is a compendium of knowledge prepared for the twentieth-century man or woman who is too busy to wade through dense volumes, in order to obtain facts and figures that are here presented in a nutshell.

In daily business or social intercourse, all persons are at times confronted by problems requiring immediate solution. To aid in readily solving them, these questions are formulated and the responses indicated. They will be found to meet the constantly recurring needs of men and women in every vocation, serving as a medium of ready reference, not only to the student and the teacher, but to the mechanic, the farmer, the artist, the railroader, the clerk, the housekeeper, the sportsman, the speculator, the clergyman, the inventor, and all seekers for useful knowledge.

The asking and answering of these questions will be a benefit to all members around the evening fireside, and prove a welcome and unique entertainment at social gatherings, where knowledge as well as pleasure is the object in view.

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